International Marine Engineering

Published Monthly by ALDRICH PUBLISHING CO.

17 BATTERY PLACE, NEW YORK — 31 CHRISTOPHER ST., LONDON, E. C.

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Edited by H. H. Brown, A. M. Inst. N. A.
Member Soc. N. A. and M. E.

Vol. XX **SEPTEMBER 1915** **No. 9**

"Unscrewing the Inscrutable"

The bungling efforts of the Administration at Washington to build up the American merchant marine in the foreign trade remind us of the story of the colored preacher who asked close attention of his hearers to the sermon he was about to deliver, as he was going to "divide the indivisible, mention the unmentionable and unscrew the inscrutable." Deadly handicaps have been put on the operating of vessels in the foreign trade by the present Administration apparently for the purpose of preventing private capital going into this branch of shipping. Then because private capital will not make investments of this kind, the Administration brings out again the horrible nightmare of government ownership. The last session of Congress, which had a very large majority vote in favor of the Administration, was decidedly opposed to government ownership, and since Congress adjourned the Chamber of Commerce of the United States has voted on this subject, and by more than eight to one expressed opposition to this form of government. We wish the Administration splendid failure in its attempt to "unscrew the inscrutable."

Steamship and Railway Accidents

In a recent issue of one of the leading railway journals figures were published showing that the risk of a passenger being killed in a train accident is several times less than the risk of his being killed in a vessel disaster. In 1906, for instance, American steamships carried 330,235,959 passengers, of whom 323 were killed in accidents, or 1 in 1,022,000. In the same year the railways carried 797,946,116 passengers, of whom 359 were killed in accidents, or 1 in 2,222,000. Again, in 1914, one passenger in every 3,029,000 carried by the steamships was killed, while on the railways 1 out of every 3,978,000 passengers carried was killed. By restricting the fatalities on the railways to "train accidents" only, the railways are put in a more favorable light, the figures for passengers killed then becoming 1 in 5,465,000 for 1906 and 1 in 12,390,000 for 1914. It must be admitted that in both rail and water transportation accidents are far too numerous. There are no satisfactory grounds, however, upon which the safety of the two modes of transportation can be compared. The causes and nature of the accidents are for the most part wholly different, and in transportation by water the hazards of the sea introduce an element of risk which so far it has been beyond the power of human ingenuity to eliminate. Disasters such as the capsizing of the *Eastland*, or the burning of the *General Slocum*, however, are inexcusable, and the Federal Government should be able to deal with and prevent cases of criminal carelessness and incompetency.

Results of the Eastland Inquiry

The outcome of the numerous inquiries into the *Eastland* disaster in Chicago, which caused the death of 844 persons, has been the indictment, on charges of manslaughter and criminal carelessness, of the officers of the company owning the *Eastland*, the general manager of the company which chartered the boat and the captain and chief engineer of the vessel. The bill against these officials contained five counts stating that the *Eastland* was unseaworthy, her ballast tanks out of repair and not properly filled, the crew insufficient to handle the boat properly, and that 2,500 passengers were allowed on board, which is more than the carrying capacity of the vessel. Commenting upon the causes of the accident, the grand jury stated that the failure to correct the instability of the boat years ago was an indication of criminal carelessness and incompetency on the part of all persons connected with the design, construction, control, operation and inspection of the vessel.

Developing the Port of New York

New York City has 578 miles of waterfront, of which the city owns 127 miles. Only 47 miles of this, however, has been well developed for terminal purposes. In the year 1914, 54.92 percent of all the imports and 36.56 percent of the exports of the United States were handled through this port. To meet future needs, a systematic development of its harbor and terminal facilities must be undertaken, and for this purpose the Committee on Port and Terminal Facilities has submitted a report to the Board of Estimate and Apportionment recommending that a commission be appointed, consisting of John F. Stevens, former chief engineer of the Panama Canal; George F. Swain, professor of civil engineering in the Graduate School of Applied Science of Harvard University, and William C. Loree, formerly general manager of the Baltimore & Ohio Southwestern Railroad, to investigate thoroughly the problem of dock development in the city and to

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formulate a comprehensive plan for the proper development of the port. The problem involves a study of the various railway and steamship terminals, their relation to business centers, the method of carrying freight through the streets and the interchange of freight between the railroad and steamship lines. It is estimated that this work will cost about $125,000 (£25,000) per year and that it will take at least two years for completion. There is no doubt but that this work will be the most far-reaching of its kind ever performed for the city of New York. It is work which should have been done years ago; but now that it is finally to be undertaken, the city is to be congratulated upon having it placed in the hands of such competent men.

The Naval Programme

That the naval programme which will be submitted by the General Board this fall will be a very liberal one is generally conceded by all reports emanating from official sources, although as yet its details have not been made public, and probably have not been finally determined. It is believed that this year the Secretary of the Navy and the General Board will agree upon one programme, whereas heretofore two separate programmes have been submitted to Congress, one from the General Board, which calls for a progressive policy of construction based upon what the Board considers as the vital needs of an adequate navy for the defense of the country, and the other from the Secretary of the Navy, which is far less liberal, and is shaped largely by expediency and the probable attitude of Congress towards military preparedness. The events of the past year, however, have brought so forcibly to the general public the importance and vital necessity of adopting a more progressive policy in the upbuilding of the United States navy that the opposition in Congress to naval expansion will undoubtedly be found to have become greatly weakened. Moreover, it is known that the President is favorably disposed towards a more liberal policy in meeting the demands of the naval establishment, and with this attitude prevailing no opportunity should be lost to overcome past delinquencies, and to place the navy on a footing commensurate with the rapidly increasing responsibilities of the nation's foreign relations.

In many ways the present period is a critical one as far as the relative value of different types of war vessels is concerned. Questions which in times of peace have been subjects of controversy, such as the importance of submarines in naval warfare, defense against torpedo attacks, the relative value of high speed in capital ships, and similar problems, are now being worked out in actual warfare. Such information as has been gained by naval observers abroad, of course, will have an important bearing on the nature of the naval programme, and for this reason the report of the General Board has been deferred until fall.

In accordance with the policy which the General Board has steadfastly adhered to, it will probably recommend at least four first-class battleships. This was the number asked for last year, when the Board reported that the fleet was deficient by ten battleships of the programme laid down in 1903. As only two battleships were authorized by Congress at its last session the deficiency of the fleet in vessels of this type has been increased. It is very probable, however, that the recommendations of the General Board will for the first time include battle-cruisers, as the great value of this type of vessel has been demonstrated in the present war. Scout cruisers—a type of vessel which has been entirely neglected in the navy since the building of the *Birmingham*, *Salem* and *Chester*—will be recommended, although probably only four will be asked for.

In view of the spectacular achievements of the submarines in the present war, and the continued activities of the belligerent nations in adding to their fleets of submarines, it is probable that a large number of these vessels will be asked for. They will be of two types—the coast defense submarine and the large cruising submarine. Various estimates have placed the number at from twenty to fifty. At least sixteen torpedo boat destroyers will be recommended, although more would be required if the ratio of four destroyers to each battleship in the fleet is to be attained, as the present ratio is less than half of that number. If the programme for destroyers and submarines is realized, tenders for both of these classes of ships will be required. The navy is also extremely deficient in small gunboats for patrol duty.

For naval aviation a large sum will be recommended in order to provide for the construction of aircraft and for the expansion of the aviation schol at Pensacola, Fla. Extensive additions to existing naval gun shops, torpedo plants and powder factories will also be recommended, together with additions to the auxiliary fleet of colliers, transports, hospital ships and supply ships. The weakness of the navy in auxiliary vessels is too well known to need further comment. This essential branch of the navy is something that cannot be supplied over night in case of emergency, and immediate steps should be taken to overcome this deficiency.

No information has been disclosed, of course, as to the characteristics of the vessels included in the new programme. Plans and specifications of the two new battleships authorized by the last Congress are now being completed, and these ships will be very similar to the preceding vessels of this class. Although turbine propulsion is adopted in the Department plans an opportunity will be given to bidders to submit alternative designs for the machinery, and in this way it is certain that the adoption of electric drive will receive careful consideration. The only new features in the new ships will probably be in the manner of subdivision and armoring of the hull to resist torpedo attacks. Recent experiments carried out by the Bureau of Construction and Repair on armored caissions to determine the effectiveness of subdivision and armor for this purpose, it is understood, have furnished sufficient evidence to enable the Depart-

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ment to make important improvements in this feature of design. Both the destroyers and submarines authorized in the last programme represent steps in advance in their respective classes—the large cruising submarine, which will be named the *Schley*, being a distinct departure, and probably the forerunner of a new ship's type.

Performance of Diesel-Engined Motor Ships

In view of the skeptical views expressed by many shipowners regarding the success of Diesel-engined motor ships, we call attention to the following extracts from a report, dated June 1, 1915, made by the Anglo-Saxon Petroleum Company, of London, owners of nine Werkspoor Diesel-engined ships, ranging from 500 to 2,200 horsepower. The report refers especially to the *Selene*, of 2,200 horsepower and 5,413 tons deadweight carrying capacity. The liquid fuel capacity of this vessel is 692 tons. With full bunkers the vessel can travel 22,800 miles without repleshing her fuel supply.

"After satisfactory trials, at which a speed of 11.3 knots was obtained, being ¾ knot above contract, the *Selene* was accepted from the builders in September, 1914, since when she has been regularly in employment, and has now traveled a distance of over 40,000 miles.

"On the voyage just completed she left Cardiff on December 19, 1914 (after her first guarantee overhaul, lasting twelve days) for Port Arthur, Texas. She then proceeded, via the Panama Canal, to North China; distance Panama-North China, 9,000 miles. (This was covered in 44 days without calling at any port.) After discharging her cargo, for which purpose she was in port four days, she made for Singapore, where she replenished her stock of fuel, having covered 14,300 miles without taking fuel at any intermediate port.

"This would not be an economical procedure in the ordinary course with a steamer, as it would result in shutting out a considerable amount of cargo, but in the case of the *Selene*, although the captain had instructions to replenish bunkers at Shanghai, he found the consumption on the run across the Pacific so economical that no additional fuel was needed at Shanghai, and with a full cargo of oil the vessel was able to steam 54 days, and in ballast 12 days, at practically full power without replenishing her fuel supply. On her last voyage the *Selene* effected a complete trip round the world, covering a distance of approximately 27,500 miles.

"It might have been reasonably expected that in the course of their first six months' running defects in the machinery would become manifest, as is mostly the case in new departures of such a radical nature, but somewhat regardless of the apparent risk, these vessels were sent across the North Atlantic and Pacific in the depth of winter as soon as they left the builders hands, and instructed to perform long-distance runs which even in the case of a new steamship would not have been quite desirable; in fact, no discrimination whatever was shown in adjusting the movements of these vessels, which have been treated as if they were ordinary steamers, and perhaps a little more severely.

"Another example of this is that the sister ship *Artemis*, after having been kept running continuously for eight months without dry-docking since the date she was accepted from the builders, has now been sent on a voyage from the Tyne, where she left on March 6, to Port Arthur, and from there through the Panama Canal to Sydney, Australia, the distance from Panama being 8,000 miles. The *Artemis* left Panama on April 17 and arrived at Sydney May 24.

"It is particularly to be noted that no facilities for repairs to Diesel machinery are available in those parts of the world, and it may be regarded as a demonstration of the great faith we have in the absolute reliability of the machinery of these vessels. It is also obvious that on these long-distance runs—where bunkering stations for steamers are few and far between—the motor vessel presents an enormous advantage by the comparatively small amount of bunkers required and the large cargoes they carry in comparison with steamers.

"The foregoing facts will show that our Diesel vessels, the machinery of which have all been constructed at the Werkspoor firm of Amsterdam, have been subjected in the first period of their running to the most severe tests, and having proved capable of standing tests better than could reasonably have been expected, we feel entirely assured of the great success we have attained with these vessels. They have now gone through their first and most trying period, and with small adjustments and improvements introduced the machinery will become more reliable as time goes on. We feel that in spite of disappointments with some Diesel-propelled vessels, there is a great future for the marine Diesel engines.

"In presenting the above particulars regarding our new vessels, we cannot refrain from again bringing to your notice the work which our little tanker *Vulcanus* has performed. We particularly desire to emphasize the fact that this boat, built in 1910 and accepted from the builders in November of that year, was the first sea-going Diesel tanker in Western Europe, and it was from this pioneer ship that we gained our present knowledge and experience in the matter of the requirements of sea-going Diesel ships, and through this boat was largely achieved the present stage of reliability and development.

"It is significant that the *Vulcanus* still shows herself to be a thoroughly useful and dependable motor ship, and we look upon her as an all-round success. A remarkable feature is that, apart from being regularly employed in our coasting trade, she has on more than one occasion been kept running for ten consecutive months without dry-docking. The latest example of this is that she was dry-docked in January, 1914, the delay for overhauling purposes being only ten days; she then ran continually till November 17. During this period the total time lost for engine repairs was 16 hours in port and 17½ hours at sea, a performance sufficiently striking to place the good qualities of this small boat beyond dispute."

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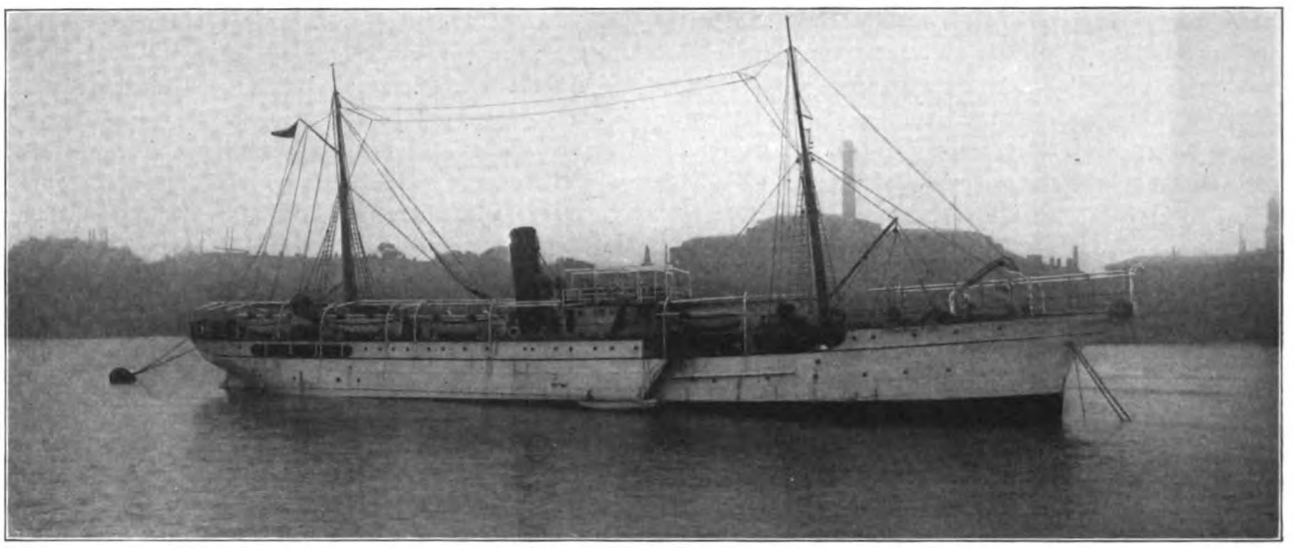

Fig. 1.—S. S. *Transmitter*, Specially Designed for Repairing Submarine Cables

Cable-Repairing Steamer Transmitter

Single Screw Vessel Built by the Goole Shipbuilding Company for the Eastern Telegraph Company, Ltd., of London

BY F. C. COLEMAN

At the present time there are in service about sixty ships specially designed and equipped for the laying and repairing of submarine cables. One of the most interesting of this special type of ship is the single screw steamer *Transmitter,* which forms the latest addition to the fleet of ten cable-repairing steamers belonging to the Eastern Telegraph Company, Ltd., of Finsbury Pavement, London, E. C.

The *Transmitter,* built by the Goole Shipbuilding & Repairing Company, Ltd., has a main deck, topgallant forecastle, awning bridge and a short poop. The following are her leading dimensions:

Length overall	221 feet 4 inches
Length on load line	200 feet
Breadth, extreme	30 feet 1¾ inches
Breadth, molded	30 feet
Depth, molded	17 feet 6 inches
Gross tonnage	903

The vessel is constructed of Siemens-Martin mild steel, and is steel riveted, and although classed in Lloyd's Registry 100 AI with special survey, certain scantlings and parts in the construction are above Lloyd's requirements. There is a flat keel plate with butts planed and flush, and the butt straps are 3/20 inch thicker than the keel plates.

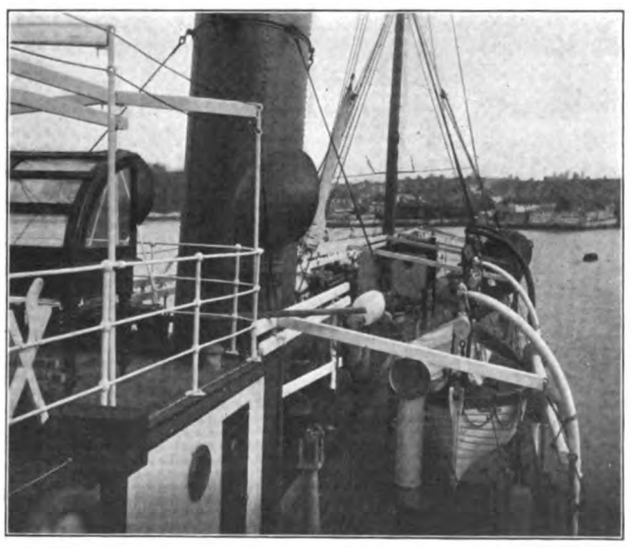

Fig. 2.—After Deck

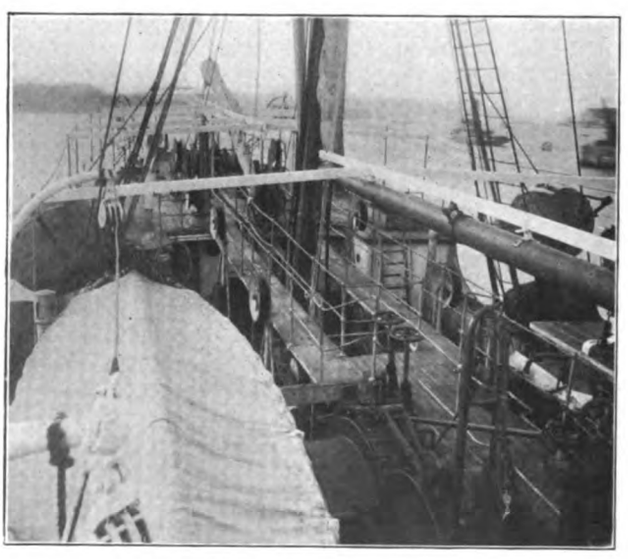

Fig. 3.—Forward Deck

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The stem is forged and swelled at the foot to take the keel plates. The stem bar is 7¼ inches wide (Lloyds 6½ inches by 2 inches). This extra width allows for the chafe of the cables, but the shell plates are kept back, as if the stem bar were only 6½ inches wide. The head of the stem is finished in accordance with the plan, so as to allow for the box-end to carry the bow gear. The stern frame has substantially forged gudgeons, steel bushed, to take the rudder pintles, and there are ample forged locking stops. The rudder has a single steel plate with forged iron head and faced coupling on the lower end. The braces and gudgeons are forged, the upper

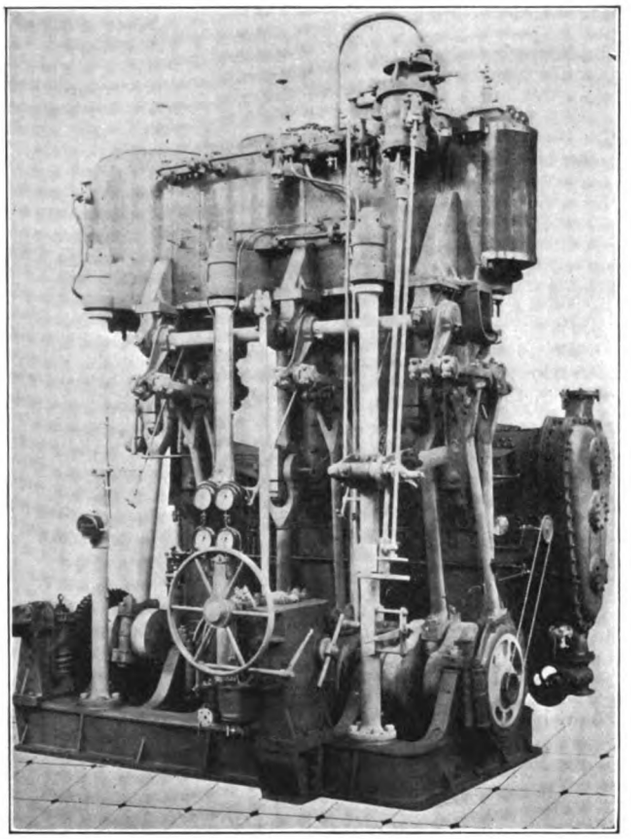

Fig. 4.—Main Engine

gudgeon locking with that of the stern post. There are portable turned pintles with coned ends, nut and split pin, and a stuffing box at the rudder head.

The frames are spaced 22½ inches apart and are of bulb angles, 6½ inches by 3 inches by .40 inch. All of the frames are run up to the gunwale plate top of the forecastle deck, to the main gunwale aft of forecastle to the front of the awning bridge and to the top of the sides of the awning bridge deck, thence to the main gunwale right aft. Counter transoms and poop frames are arranged and frames are cut at the margin plates of the forward ballast tanks, while small limber holes are in all of the frames and floors at the level of the top of the cement.

The reverse frames are chiefly angles 4 inches by 3 inches by .34 inch, and where there are no reverse bars lugs of larger angles for stringers are riveted to the frames.

The web frames are arranged two on a side in the forecastle to suit the ends of the tanks and at the flare of bow

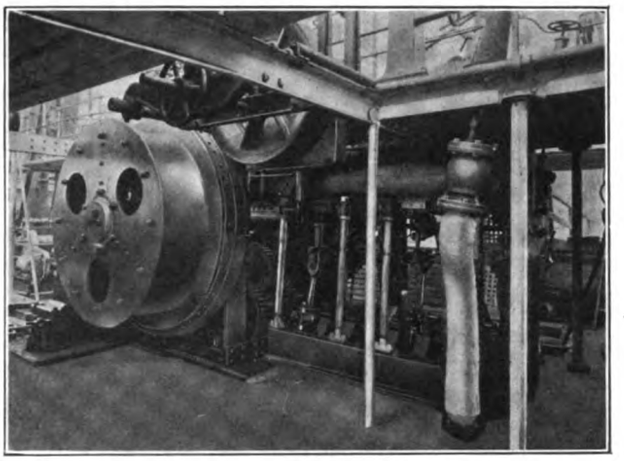

Fig. 5.—View of Cable Gear, Looking Forward

of 9-inch bulbs. In the cable gear there are two web frames on each side 12 inches wide, with a 12-inch channel steel beam at the top of each web frame, and a 9-inch web frame takes the channel steel beam at the back of the boiler.

The whole length of the vessel has ordinary floor plates carried straight across. The floor plates are sheared ½ inch clear above the bottom of the frames. The deep floors aft through which the stern tube passes are .34-inch thick, with suitable access and manhole door from the watertight flat.

FORWARD TANKS

The three forward separate tanks, Nos. 1, 2 and 3, are divided on the centerline with watertight division and piping and suction serve both sides of the tank, the piping being carried through the bulkhead bunker into the stokehold and there connecting on to piping to the pump. Easy access is obtained to all the ballast tanks by means of McNeale's patent manhole doors. There are strong galvanized iron box strums with hinged lids to all suctions, and all the bends of piping are protected where passing corners of steelwork with properly fitted chocks.

The ballast tanks (Nos. 3 and 4) next the after engine room and forward bunker bulkhead are reserved for fresh water for the main boiler and have separate piping and cocks to main feed pump in the engine room. The tops of the ballast tanks are covered with Wailes, Dove's bitumastic cement, and there is a light calked ceiling 2

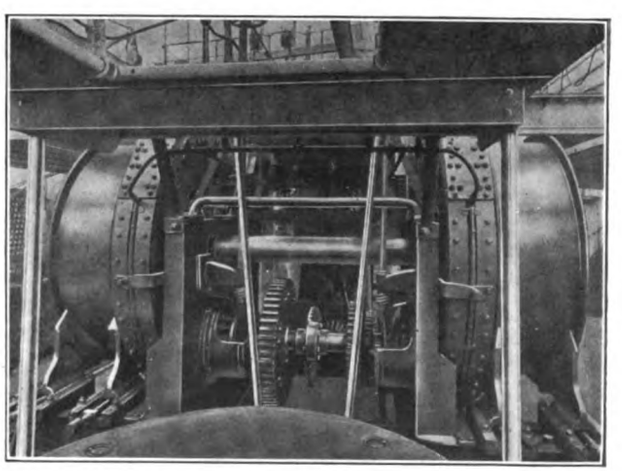

Fig. 6.—View of Cable Gear, Looking Aft

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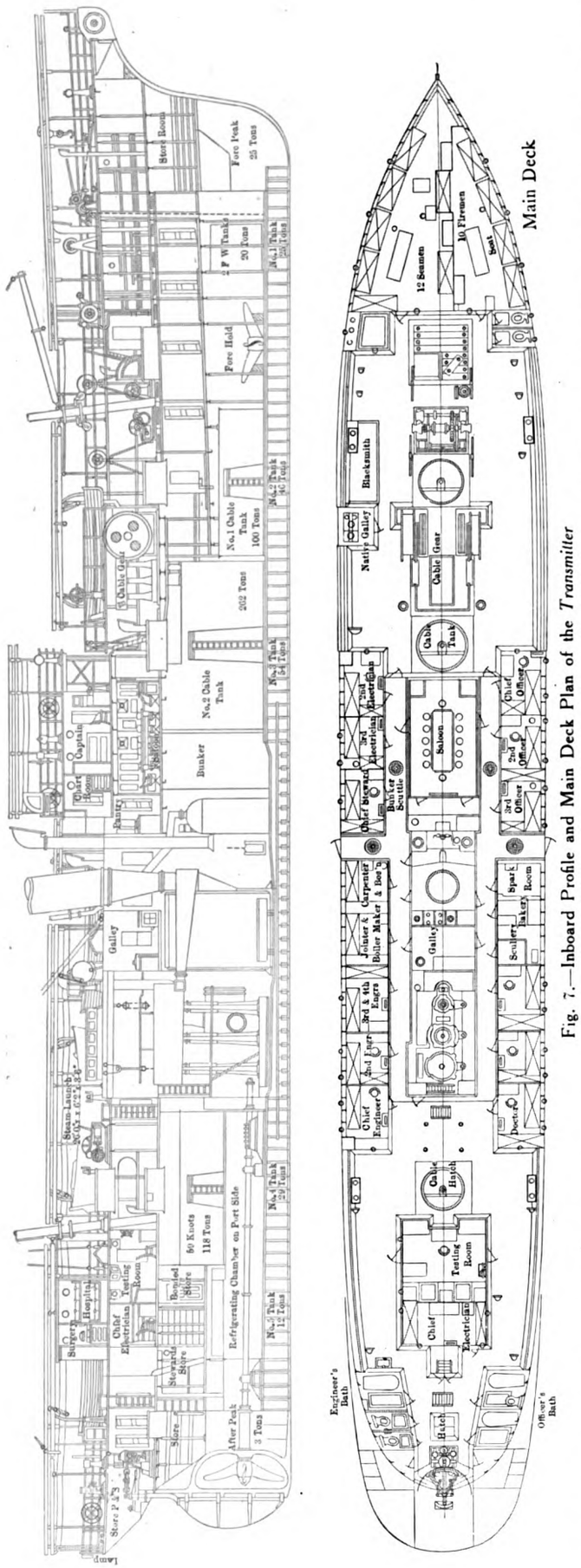

Fig. 7.—Inboard Profile and Main Deck Plan of the *Transmitter*

inches thick where necessary. The lower parts of the bulkheads from the keel to about 4 feet above the tank tops are .32, upper parts .28, except the bulkheads to fore and aft peaks, which are .32 throughout.

The main bulkhead, partly formed by the after end of No. 2 cable tank with wide partitions was specially considered with regard to scantling and detail and the after end of the cable tank was covered with a 2-inch thickness of African asbestos, with groundings of 2-inch ceiling, joiners' screws, and occasional tap screws being used. Where side stringers pass through the bulkheads they have steel shoes fitted on the bulkheads and to stringers and are calked. The overlapping butt-ends of the plates are planed and all the landings are joggled. At all the spigoted engine valves, or sea-inlets, the discharges and under sounding pipes have doubling plates fitted closely in one space of frames. The sides of the houses are plated with outside butt strips, as also all deck structures with deep and strong coamings.

The bilge keels for half-length amidships are of 10-inch by 8/20-inch bulbs, and a tee bar 5 inches by 3½ inches by 8/20 inch. The bulb bars are tapered at each end, and the fore ends have shaped Jarrah wood chocks with galvanized iron bolts through and through.

From forward of the cable gear to the first beam aft of the after main bulkhead and between the gunwale stringer plates are .30-inch thick plates across the vessel, butt strips and amidship tie plates. The angle, 3½ inches by 2½ inches by ⅜ inch, is worked along each side to take the teak margin plank and to form a waterway. The main keelson is lowered under the boiler so as to be intercostal within the main boiler space, and the angles on the top of the floors and those taking the intercostal plating are of such scantling as to give the maximum clearance under the boiler.

Cable Tanks

In the forehold there is a tank 21 feet diameter by 6 feet 6 inches deep, and another tank 24 feet diameter by 12 feet deep, while in the after hold there is a third tank 22 feet by 6 feet 6 inches deep. The tank cones are 5 feet diameter at the base and 4 feet diameter at the top, with 5/16-inch plate, with butts planed and butt strips fitted internally. There is a special arrangement of heavy stanchions, 3½ inches and 3 inches diameter, fitted under the cable gear, also on the top of the fore end of No. 2 cable tank, while there are stanchions under the masts, the forward ones under the hold being placed so as to give the maximum clear space for the cable buoys.

The disposition of the various apartments and machinery spaces is so clearly illustrated in the drawings as to render unnecessary any further detailed reference. The *Transmitter* is designed to carry a crew of fifty-five. The captain's quarters are on the bridge deck, and comfortable, well-fitted accommodation for the officers, electricians and engineers is provided on the main deck. On the lower deck aft of the engine room is the engineers' workshop, with entrance from the engine room, and there is here a small vertical engine driving shafting and pulleys and fitted to the under side of the main deck and working a lathe and a drilling machine. There is also a workman's bench supplied with vise complete.

On the forecastle, bridge and main decks there are the most modern appliances provided for the delicate and difficult services of laying and repairing submarine telegraph cables. This equipment comprises a steam cable machine, two dynamometers, turning-over gear and bow sheaves and a Lucas sounding machine.

The cable gear, constructed and installed by Messrs.

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Johnson & Phillips, Ltd., of the Victoria Works, Charlton, S. E., is claimed to be the most highly finished machinery of its class fitted on any cable steamer. Every gear wheel, even the large gears on the main drums which have 70 teeth 3¼-inch pitch, was machine cut from the solid, all the larger wheels being of cast steel, while the pinions are of Immadium bronze. Several of the steel wheels were "muffled" in accordance with a suggestion of Messrs. Johnson & Phillips, so as to eliminate the "ring," the result being that the gear works with a minimum of noise and rattle.

CABLE GEAR

The cable gear is a combined picking-up and paying-out machine having two drums, but with one engine, the drums being independent of one another, so that while one is picking up, the other can be paying out under control of the brake. The drums run loose on the drum shaft, which is a fixture in the frames, making a very rigid job. They are internally geared and are connected to the second motion shaft by machine-cut bronze pinions which are carried on a shaft in special pocket bearings attached to the main frame, and so constructed that the pinion can slide into gear through large holes in the frames, making a very compact job. The engine is coupled to the first motion shaft by means of machine-cut bevel gear. The drum pinions and the speed wheels are slid into gear by means of wipers actuated by worm gearing and handwheels from the platform deck above.

All the controlling mechanism is arranged on the top deck, the steam stop valve, reversing lever, main brakes, holding back gear brakes, all being within arms' reach of the attendant. The drums are 5 feet 8½ inches diameter on the tread by 1 foot 7 inches wide between the flanges, and they are geared for two speeds, for nominal lifts of 15 tons at one knot, and 6 tons at 3 knots, but the engine is a very powerful one, having three cylinders 11½ inches diameter by 13 inches stroke, thus enabling the gear to deal with any lift that it may be called upon to do.

Evidence of this was given while the lift tests were being made, the load of 15 tons being picked up with great ease, and the valve gear is so adjusted that it is possible to haul up quite steadily even a few inches. Each drum is provided with a large brake ring, encircled by a brake band consisting of steel straps fitted with elm blocks, and on the back of each strap a water service pipe is attached having small nozzles at intervals to allow the water to be delivered equally all around the brake ring, so as to permit of paying out fairly long lengths of cable.

The propelling machinery was constructed by Messrs. Richardsons, Westgarth & Co., Ltd., of Hartlepool, according to a specification embodying the latest improvements for a vessel of this class, special attention having been paid in the case both of the main engines and auxiliaries to secure economy of steam consumption and fulfil the exacting requirements of a cable ship. The bearing surfaces throughout are exceptionally large and great care has been exercised in the design generally to secure accessibility of all the various working parts and of the larger number of auxiliaries contained in the engine room.

PROPELLING MACHINERY

The engines are 17 inches, 28 inches and 46 inches diameter by 33 inches stroke, each being steam jacketed and fitted with flat, balanced slide valves, the low-pressure having its valve placed at the back of the engines in order to economize space. The reversing gear is of the all-round type, driven by a powerful and specially designed engine to facilitate the rapid handling of the main engines when the vessel is engaged in cable work.

The condensing and feed heating arrangement is very complete. This comprises the latest development of "Contraflo" system with compensator exhaust steam surface feed heater, with which is combined an oil separator and oil extractor. The main condenser is of the "Contraflo" type, designed to maintain a high vacuum in all temperatures of sea water, which is specially applicable to a ship engaged in tropical waters; the auxiliary condenser is also of the "Contraflo" type. The main feed pumps are of the slow speed independent type and work in connection with a Cascade filter arranged with float

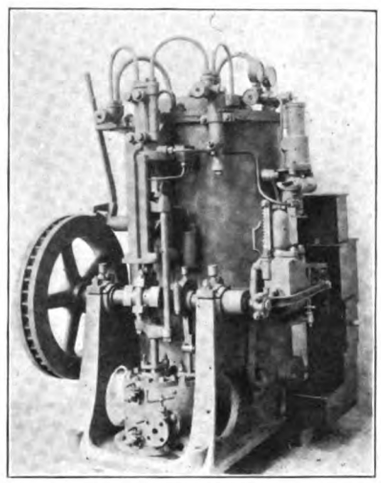

Fig. 8.—Steam-Driven Combined CO_2 Type Refrigerating Machine of the *Transmitter*

control. The accessories on the main engines include an Aspinall's governor, speed indicator, and revolution counter for cable work, etc., and in addition to the auxiliaries forming the "Contraflo" system a separate centrifugal pump is fitted, also auxiliary feed pumps, large ballast pump, Morison's evaporator, etc.

In the engine room are also installed the electric light and refrigerating plants. Steam is supplied by one large forced draft boiler fitted with "Economic" fronts and Sturrock's bridges. The working pressure is 175 pounds per square inch. The fan and engine are by Bumstead & Chandler and the stokehold fittings include a Compton's ash hoist, etc.

On the trial trip, which took place off the mouth of the Humber, a mean speed of 11.2 knots was obtained and the engines and all auxiliaries worked in a most satisfactory manner.

REFRIGERATING MACHINERY

The refrigerating machine was supplied by Messrs. J. & E. Hall, Ltd., of Dartford, and is one of their steam-driven CO_2 type, and, as will be gathered from the illustrations, the machine forms a very compact and complete unit. The CO_2 compressor is driven direct by the steam cylinder, which can be seen carried in the bottom of the frame. The brine pump and the condenser water circulating pump are both driven in tandem off the end of the crankshaft. The body of the machine forms a casing for the CO_2 condenser coils, around which the condenser water is circulated by means of the pump already mentioned. Inside the base of the machine a wrought iron casing is fixed, the space between the inner casing and the outer

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casing being filled with granulated cork for the purpose of insulation. The evaporator coil is placed inside the wrought iron casing. Around this coil the brine is circulated through electrically-welded grids, which are fitted in the provision rooms, and by this means a low temperature is maintained for the preservation of the food for the use of the officers and crew. A special tank for the production of ice is also supplied.

There are two large refrigerating chambers, for the preservation of meat and vegetables, in the after hold, with a complete system of brine piping carried from the ice machine. Fresh provisions and a supply of ice naturally add very greatly to the comfort of the officers and crew, particularly when the vessel is working in hot climates.

Electric Plant

The electric light installation is a very comprehensive one, and was carried out by Messrs. Clarke, Chapman & Co., Ltd., of Gateshead-on-Tyne. The engine is of the open marine type, single cylinder, double-acting, coupled to a compound wound dynamo with an output of 100 amperes, 100/105 volts, when running at a speed of about 350 revolutions per minute. The contract also included the supply and erection of the main switchboard, cables, wiring, section and distribution boxes, fittings, fans, lamps and the usual accessories for no fewer than 235 points and 226 lights and 15 fans, as also the masthead light, three cable lanterns, and one Morse Signaling Lantern on the masthead, which latter is of Wightman's patent.

The deck machinery includes a powerful windlass, manufactured by Messrs. Emerson, Walker & Thompson, of Gateshead, which is fitted on the forecastle deck. There is a combined steam and hand steering gear manufactured by Messrs. R. Roger & Co., Ltd., which is fitted within the poop, and is controlled by a system of rods and a wheel from the navigating bridge.

Inclusive of a steam launch there are eight boats. The steam launch, supplied by Messrs. H. Hamblin & Co., of Blackwall, E., has a length overall of 26 feet, a depth molded of 3 feet 6 inches, and a beam of 6 feet 2 inches. It is built of mahogany, and the stern chock is of stout oak, well bolted. The compound steam engine, of Mumford's type, is capable of giving the boat a speed of about 9 knots. This launch is designed for towing cables, etc., and other hard work at sea.

Wireless Installation

The wireless telegraph installation, manufactured and erected by Messrs. Siemens Bros. & Co., Ltd., Woolwich, upon the quenched spark system for which it is claimed an efficiency of from 50 to 75 percent is obtained, the efficiency of the old open spark stations being only from 25 to 33 percent. The adoption of this system has also made the building of a special cabin and spark gap chamber unnecessary upon the *Transmitter*, the quenched spark installation being practically noiseless. Another advantage obtained by the adoption of the quenched spark system is that, the note emitted being musical in character, the station can be heard even when electrical discharges are as much as ten times as intense. A much longer period of working is thus obtained, together with an increased range.

The source of energy of the installation is a motor generator set consisting of a direct-current motor of about 1½ horsepower driving an alternating current generator of 1 kilowatt output at 220 volts, 500 frequency. The speed of this motor can be adjusted over a range of about 30 percent of the normal speed for the purpose of adjusting the pitch of the note transmitted. This motor generator set is installed in what is known as the "spark room," and the necessary leads run from there to the wireless telegraph apparatus proper, which is situated in the cable-testing room.

The alternating current from the generator is stepped up from 220 volts to 8,000 volts by means of an iron core transformer. A choking coil is provided in the low tension circuit in order to obtain the necessary resonance between the low tension and excitation circuit. The excitation circuit consists of an iron-cased condenser with glass dielectric and oil insulation, an inductance of copper strip and a quenched spark gap. The latter consists of a number of copper plates silver-faced, separated by mica rings.

The excitation circuit is enclosed in a wooden case upon the back of which is provided a hot-wire-ammeter. Slots are cut in the top of this case, through which plug sockets are fixed corresponding to the positions required for the inductance for the 300 and 600 meter wave-lengths. Connections are made from these plug sockets to an inductance of the variometer type, which serves to obtain the correct resonance between the excitation circuit and aerial.

Range of Wireless Station

The receiver is of the well-known Siemens Telefunken type, which combines long wave-length range together with simplicity of operation. The detectors, two of which are mounted upon the receiver, are of the contact type. The coupling of the primary and secondary coils of this receiver is capable of very large variation. The wave-length of the receiver is from 200 to 2,000 meters. In order to prevent damage to the detectors and receiving apparatus during transmission, a special form of switch is provided at the back of the receiver which insures that transmission cannot take place until all the receiving circuits are broken by means of this switch. The ranges over which this station will work have been guaranteed as 150 nautical miles by day and about 250 miles by night, but from the previous experience of Messrs. Siemens it is expected that the actual working range will be greatly in excess of these figures.

As the *Transmitter* will be required to work in tropical climates, special consideration was paid to the lighting and ventilation of the various apartments and machinery spaces. Two sidelights and separate ventilator cowls are fitted to each cabin, while the workshop, lower deck and crew space are all well lighted and fitted with large ventilator cowls, and all of the ventilators are carried well over the weather deck. Double canvas awnings are fitted from stem head to stern.

Sanitary provision is made according to the conditions of the vessel's working stations abroad, for besides the making of ice, there is a hospital fitted with two Admiralty cots, a porcelain bath, a sofa and a small, fitted-up surgery.

In the design of the vessel regard has been given to her working in shallow waters and good stability with easy motion when at sea. It will also be seen that within limited dimensions endeavor has been made to bring this cable-repairing vessel up to date. The hull and machinery of the *Transmitter* were built to the specification and under the supervision of Mr. P. L. Isaac, the superintending engineer of the Eastern Telegraph Company, Ltd.

Monthly Shipbuilding Report.—The Bureau of Navigation, Department of Commerce, reports 130 sailing, steam and unrigged vessels of 16,565 gross tons built in the United States and officially numbered during the month of July. In accordance with the act of August 18, 1914, two foreign-built vessels of 2,910 gross tons were added to the American merchant fleet during the month.

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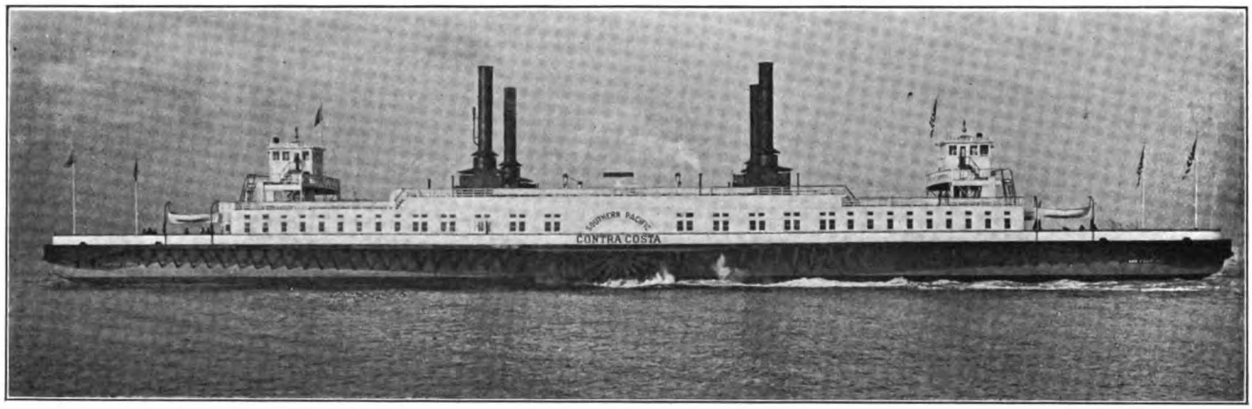

Fig. 1.—The *Contra Costa* on Her Trial Trip

Side-Wheel Car Ferry Contra Costa

Details of Design and Construction of Largest Side-Wheel Train Ferry in the World

BY EDWARD W. OLIN

The Southern Pacific Railroad Company recently placed in service the new side-wheel car ferry steamer *Contra Costa,* which is probably the largest car ferry of her type in the world. She was especially designed to carry freight and passenger trains across the Carquinez Straits between Port Costa and Benicia, Cal., which lie on the company's trans-continental lines.

The steamer is of the following dimensions:

Length overall	433 feet 4 inches
Length over transoms	420 feet
Width over guards	116 feet
Beam, molded	66 feet 6 inches
Depth, molded	19 feet 5 inches
Light draft	5 feet 10 inches
Light displacement	3,400 tons

While a brief description of the *Contra Costa* appeared in the November issue of INTERNATIONAL MARINE ENGINEERING, it is the intention of this article to give a more detailed account of her design and construction, as several inquiries concerning her have already been made, testifying to a more than local interest in this boat.

The boat is constructed entirely of Oregon pine at an approximate cost of $400,000 (£82,500) and is to relieve the old steamer *Solano,* which has been in almost continuous service since 1879. Until the completion of the *Contra Costa* the *Solano* was regarded as the largest car ferry in the world, being exceeded in length by the new ferry by only 13 feet.

The service for which she is intended is unusually severe, making an average of 46 trips with trains every 24 hours. No especial rules are observed in loading or unloading trains other than to load the first train on the

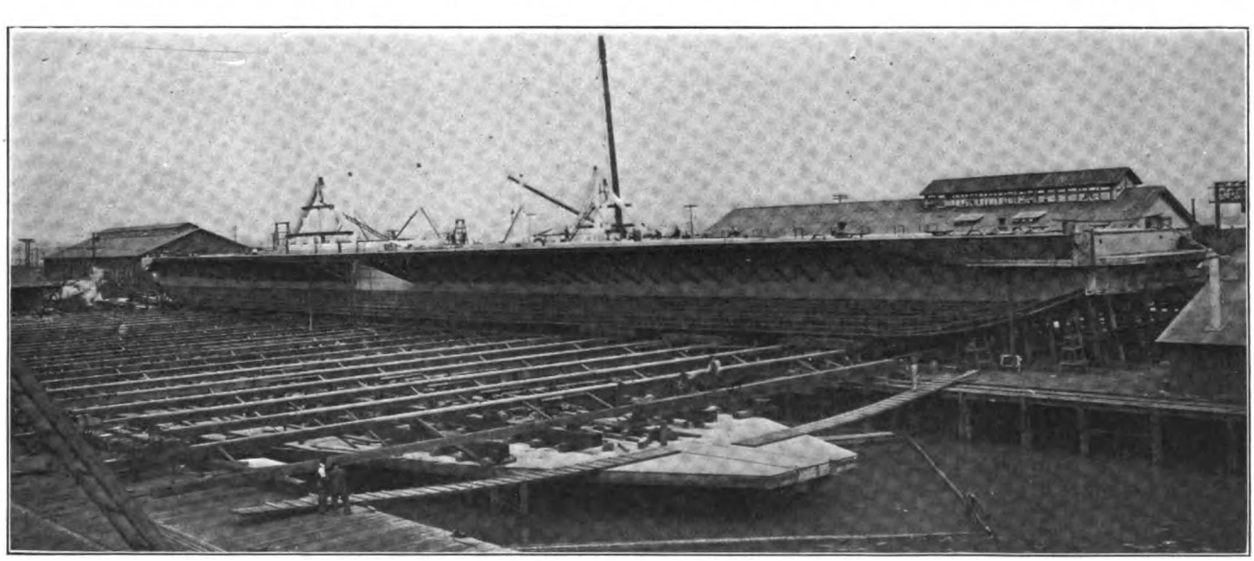

Fig. 2.—The *Contra Costa* Ready for Launching

Note that the boat is side hauled about 100 feet into a Crandall marine railway from which she was launched. Nineteen minutes were required to side haul the boat.

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inside tracks. It is usual, in the case of long trains, for the locomotive to pull her train aboard after breaking the train in the several units, while a switch engine fills up the other tracks and goes across with the cargo. It is no uncommon sight to see the heavy locomotives stand on diagonally opposite corners, thereby subjecting the hull to very severe twisting strains. As the boat is operated in connection with the regular train schedules it is obvious that absolute reliability is a most essential factor, and any delay in the operation of the boat means a readjustment of the time-tables with its attending confusion. No expense was therefore spared in the equipment of engines, boilers and auxiliaries, all of which are designed with plenty of reserve power.

The Carquinez Straits is a narrow strip of water, one mile wide, connecting the San Pablo and Suisun Bays. There is a rise and fall of tide of 10 feet, while the ebb and flow of the tide create a current of 7 miles per hour. The trip across is made in 8 minutes, which includes making the boat fast in the slips and to the aprons.

Four tracks, 12-foot centers, extend the full length of the deck, giving a total of 1,680 feet of track, which is

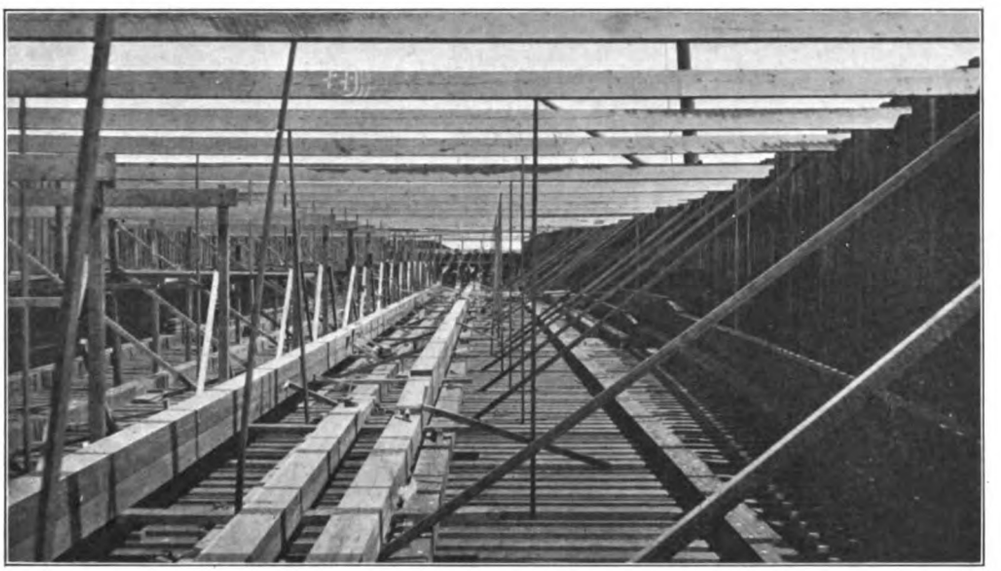

Fig. 3.—Inside View from One End of Hull, Looking Fore and Aft

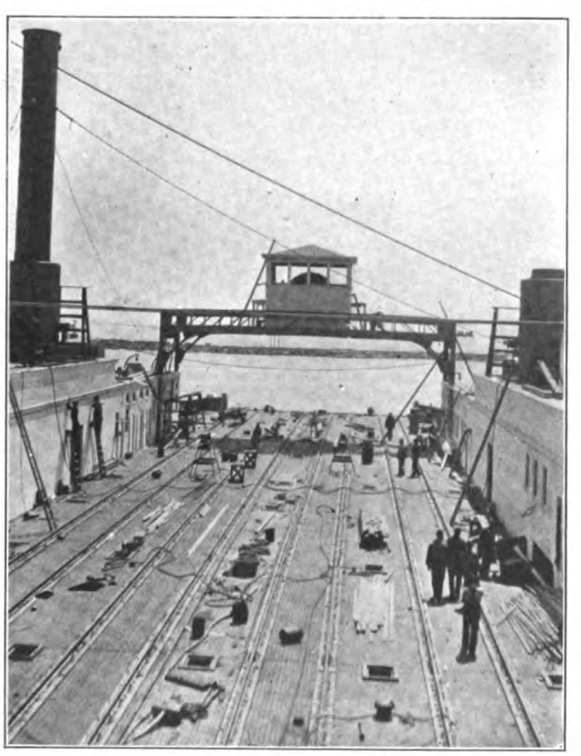

Fig. 4.—View of Main Deck, Showing Railway Tracks Spaced 12 Feet Between Centers

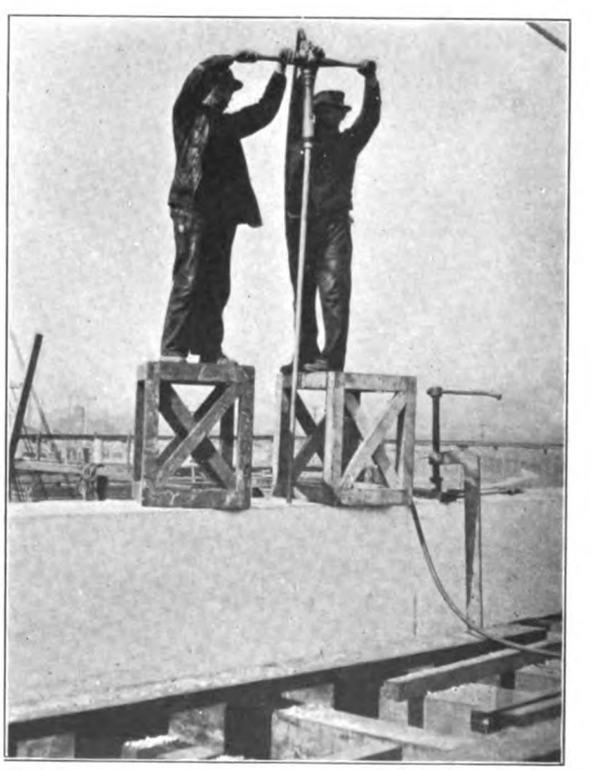

Fig. 5.—Driving a 1⅛-Inch Diameter Drift Bolt 7 Feet Long Through 26-Inch Waterway

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entirely unobstructed by hog posts, hog chains or masts, giving a very clear and open deck. A pilot house is

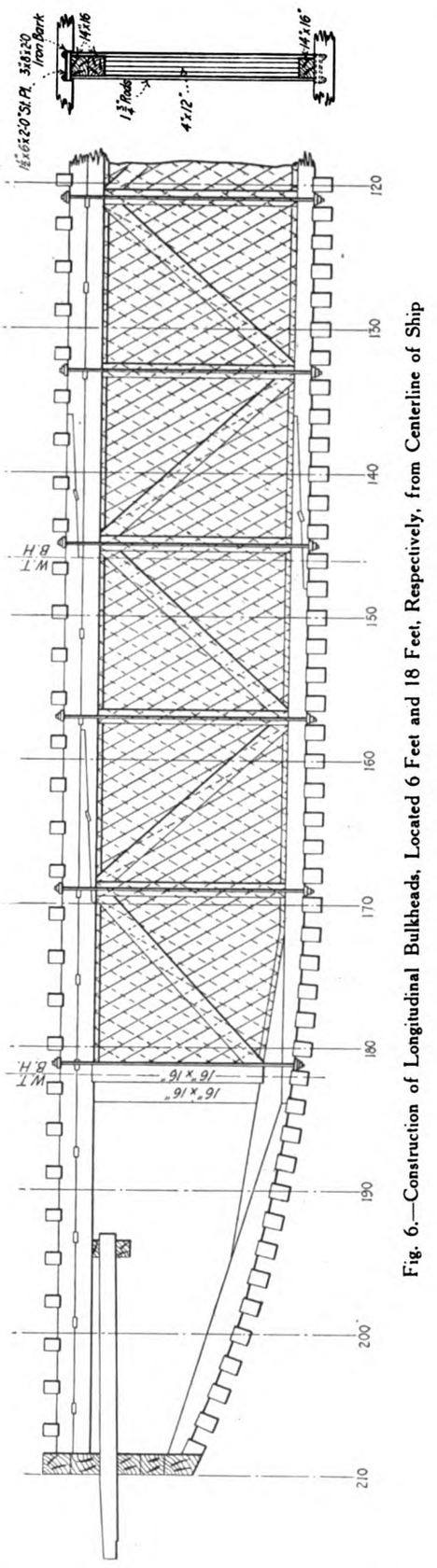

Fig. 6.—Construction of Longitudinal Bulkheads, Located 6 Feet and 18 Feet, Respectively, from Centerline of Ship

located on a steel bridge on each end of the boat. The superstructure extends 275 feet fore and aft on each side of the boat and encloses all the boilers, engineers' stands and operating platform; a restaurant and galley; a bar; a ladies' lavatory and waiting room; a men's lavatory and waiting room; a carpenter shop and ship stores, and the usual accommodations for the officers and crew, besides a waiting room and office for the accommodations of the train crew.

When fully loaded the *Contra Costa* will accommodate 36 freight cars and 2 locomotives, or 17 standard Pullman passenger coaches and 3 locomotives.

HULL CONSTRUCTION

As may be expected, the lines are similar to those of an ordinary barge; the sides are vertical, fairing in from 66 feet 6 inches beam amidships to 46 feet at the transoms,

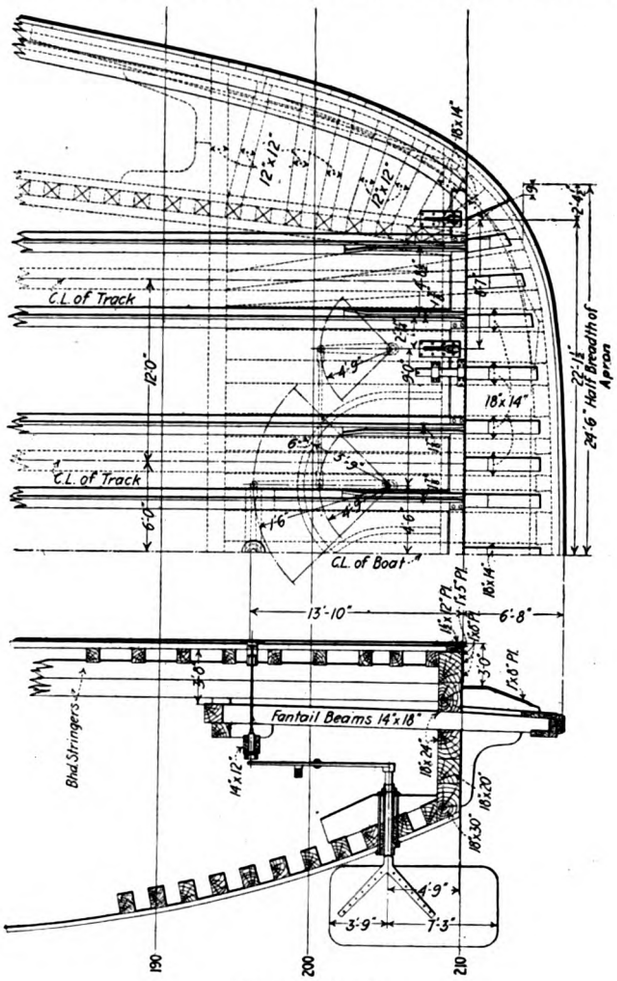

Fig. 7.—Fantail

with an 8½-foot rise of keel on each end, commencing about 35 feet from the transoms.

More than 2,000,000 feet of lumber were used in the construction of the hull alone and about 105 tons of galvanized iron fastenings. Some of the largest timbers in the boat were the six wheel beams, each of which is 18 inches by 18 inches by 116 feet long; two spring beams, each 26 inches by 36 inches by 66 feet long, and the timbers of the knuckle keelsons, which are 22 inches by 24 inches by 60 feet long.

The ordinary deck beams are 10 inches by 12 inches spaced 36-inch centers throughout and extend in one piece from guard to guard. The top timbers are 12 inches by 12 inches spaced 24 inches throughout, and the floor timbers 12 inches by 16 inches in one continuous length spaced 24-inch centers and fastened at the knuckle to the top timbers, which are notched 4 inches over the

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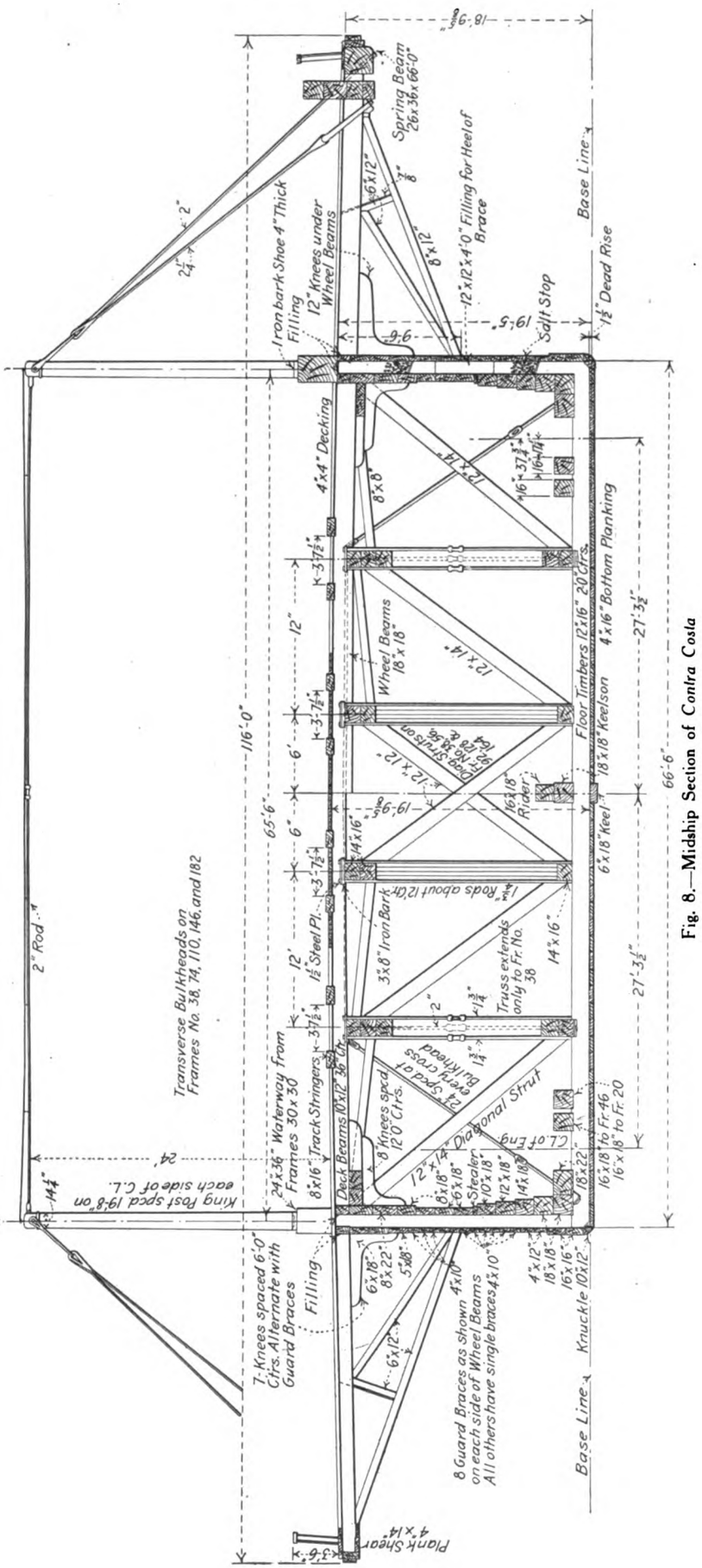

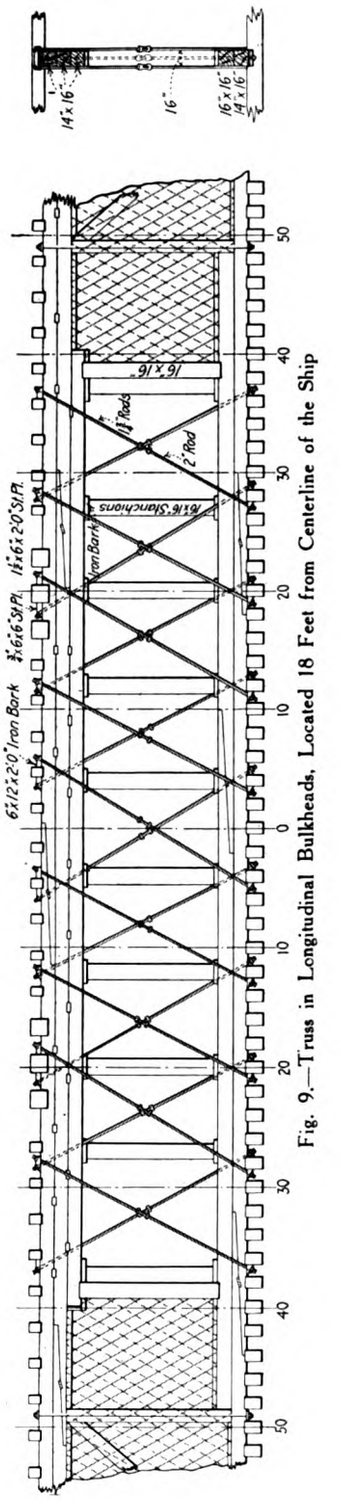

Fig. 9.—Truss in Longitudinal Bulkheads, Located 18 Feet from Centerline of the Ship

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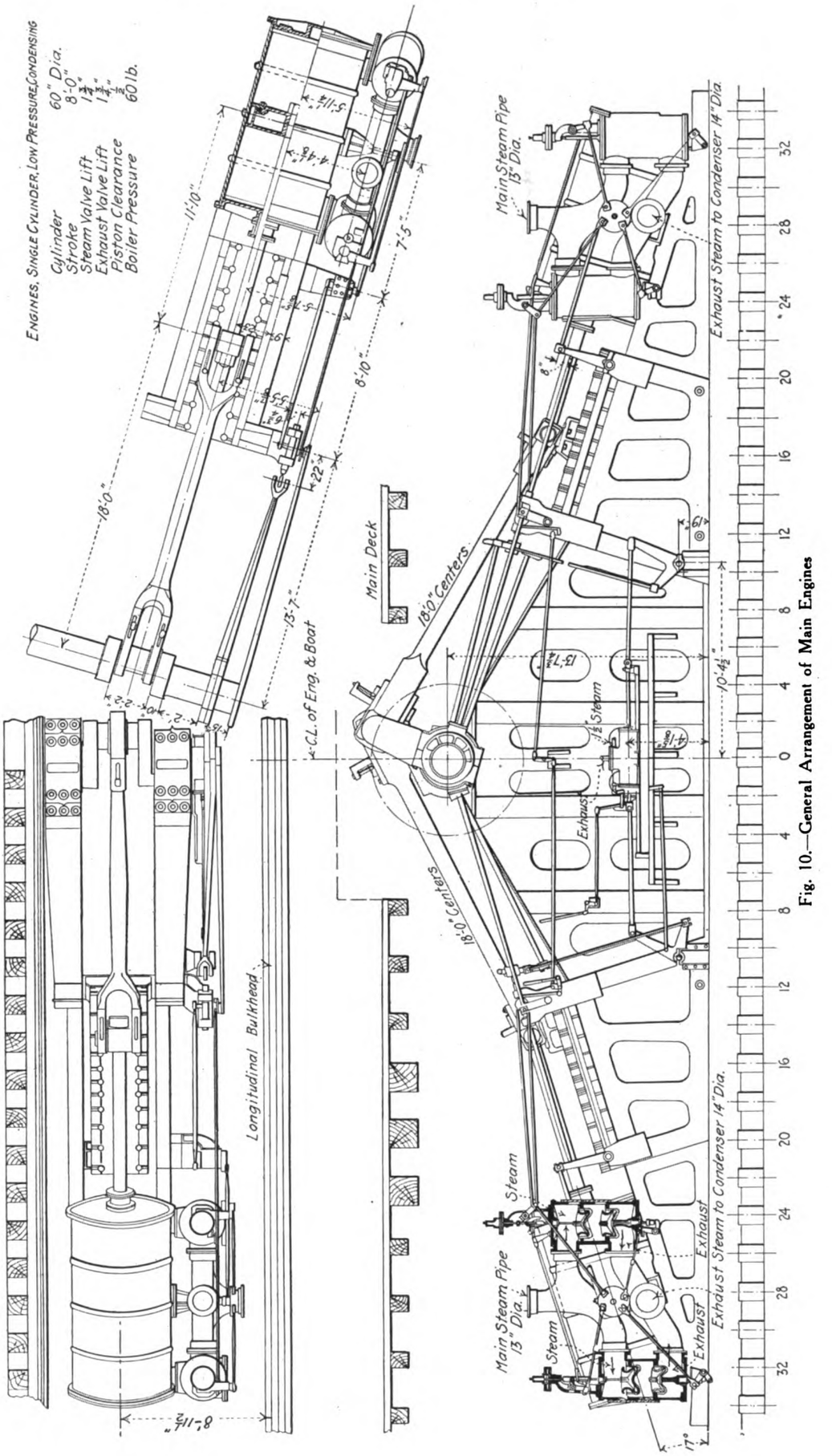

Fig. 10.—General Arrangement of Main Engines

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floors and bolted together with two 7/8-inch bolts. The center keelson is 18 inches by 18 inches in lengths varying from 50 to 80 feet and is stiffened by a rider keelson 16 inches by 18 inches in lengths to break the scarphs of the center keelsons. The center keelsons are notched over the floor timbers 1 inch deep; the scarphs are 12 feet long with 4-inch nibs. Four fore and aft bulkheads extend from collision bulkhead to collision bulkhead, being spaced 12-foot centers and centering on the track centerlines. The hull is further subdivided into 11 watertight compartments by 10 cross bulkheads.

CEILING

The ceiling represents some of the largest timbers in the boat and runs in diminishing sizes from the knuckle keelsons, which are 18 inches by 22 inches and 22 inches by 24 inches, varying in lengths from 60 to 80 feet to the two clamp strakes, 8 inches by 22 inches, under the deck beams. The ceiling is really the backbone of the hull and is a network of steel fastening running up and down, and through from the sides securing the heavy ceiling timbers to the top timbers and floors and to each other. The edge fastening is driven through the lower ceiling timbers and riveted over clinch rings on the outside of the floor timbers, but in the upper strakes the edge bolts are driven through three of the lower strakes and staggered at intervals of 3 feet. All fastenings in the lower heavier strakes are 1⅛-inches diameter, but in the upper lighter strakes the fastenings are reduced to 1-inch diameter. All drift bolts were driven and clinched with a Boyer air hammer, the holes being drilled 1/16 inch smaller than the bolt.

All scarphs in the ceiling were 12 feet long with 4-inch nibs and each fitted with two flat laurel keys 2 inches by 8 inches wide driven through the joint, instead of relying entirely on the steel edge fastening. The seams in the upper five strakes of ceiling have 2-inch by 8-inch flat laurel keys driven at about 8-foot centers.

As a means of preserving or "pickling" the lumber, two rows of salt stops are fitted between the top timbers in the space between the ceiling and outside planking and packed with 36 inches of "Liverpool" rock salt. About 80 tons of salt were used for this purpose.

PLANKING

The bottom planking is 4 inches by 16 inches fastened to floor timbers with three 7/16-inch by 7-inch spikes and one 1¼-inch diameter locust treenail, which is driven through each floor timber and wedged on both ends. All butts have composition spikes fastening.

The side planking consists of two strakes of 6-inch by 16-inch plank at the knuckle, but as it would be impractical to fasten through the knuckle keelson with treenails on account of the extreme lengths, short locust treenails were resorted to and wedged on the outside in the usual manner. The rest of the planking is 4 inches by 10 inches, and besides having the regular spike fastening is treenailed through the top timbers and ceiling with 1¼-inch diameter treenails, being in some cases 36 inches long. All treenails were driven with an air hammer. The sheer strakes consist of two strakes of 6 inches by 18 inches and one 5 inches by 18 inches, varying in lengths from 50 to 80 feet, and are bolted through top timbers and clamp strakes with 1-inch threaded bolts having flat, oval heads.

The guard, which extends around the hull of the ship, is of a rigid construction, the deck beams, as before mentioned, extending through the hull in one continuous piece. On the outside of the hull each alternate deck beam is fastened to the outside planking and sheer strake with 7-inch knees, which are fitted in place and dirft bolted through the planking, top timbers and ceiling. On the inside of the hull 8-inch knees are hung and fitted to the the deck beams at 12-foot intervals, being fastened to the same deck beams as the outside knees and taking the same fastening. The outer ends of the deck beams are covered with a 6-inch by 14½-inch Oregon pine facia, to which is fastened the regular 4-inch by 14-inch iron bark fender. Two strakes of 4-inch by 14-inch covering board on the top and bottom cover the ends of the deck beams. Filling blocks are fitted and fastened between the deck beams at the gunwale, as well as at the ends of the beams.

Each end of the boat has an apron pit 50 inches deep built into the transom, consisting of 14-inch by 18-inch timbers radiating from a common fantail beam located inside the hull and somewhat below the regular deck beams. This part of the boat is of particularly rigid construction, as it receives all the heavy pounding of locomotives and trains running on and off the boat. The bottom transom timber is 18 inches by 30 inches by 46 feet long, while the others are 18 inches by 24 inches. All stringers, keelsons, ceiling and fantail beams terminate at or are fastened to the transom with 1¼-inch diameter drift bolts through 10-inch, 14-inch and 16-inch knees. The outside of the transom, as well as around the nose of the boat, is pretty well covered with 1-inch by 8-inch steel plates to protect the wood from being marred by chafing against the heavy steel aprons.

RAILWAY TRACKS

The track stringers are of 8-inch by 16-inch Oregon pine notched 1½ inches over each deck beam and extend from transom to transom. To these stringers is fastened the 90-pound R.A. rail, which rests on 7/16-inch tie plates in much the same manner as in land practice. Tee-headed lag screws ¾-inch diameter are used to bolt the rails down, about 10,000 being used for this purpose. The tracks terminate on a 1½-inch by 12-inch steel plate which rests on 5-inch of iron bark 14 inches wide, which protects the softer wood in the transom timbers from the severe pounding of the trains. At the end of each track are two bumper blocks, which comprise a very simple though effective arrangement, consisting of 10-inch square Oregon pine blocks anchored across the rails and held in place by a steel collar and chains made fast to the eyebolts in the deck. To clear the tracks the deckhand slips the collar off the blocks and rolls it aside.

The seams of the bottom and sides as far up as the waterlines were calked with four threads of oakum and then cemented, the heavier strakes receiving 5 threads. Seams in the wake of the paddle wheel were puttied. Decking was calked with two threads with the intention of adding two more threads in a year or so after all fastening has pulled itself tight.

As may be expected, all the lumber was furnished under a very rigid set of specifications and considerable difficulty was experienced in procuring first-class ship's lumber of the quantity and dimensions required. The lumber was furnished by the Tacoma & Eastern Lumber Company, the Eastern and Western Lumber Company, of Washington, and the C. R. McCormick Lumber Company, of Oregon, and was, in the opinion of experts, very fine material.

While it is possible to design a more modern gear for controlling the rudders, the arrangement finally adopted can best be appreciated when the condition under which the boat operates is considered. As the straits across

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which the boat operates is very narrow the tide runs like a millrace which is ever threatening to carry the boat towards the submerged rocks that line the shore. When this happens the rudders are sheered off like so much brush, and as it is almost impossible to tie up for more than a couple of hours at a time, some simple, efficient and inexpensive gear must be designed that can be replaced within a very limited time. There are four rudders at each end of the boat made of 4-inch Oregon pine planks with 5-inch diameter forged steel rudder stocks. The rudder stocks are shipped up through a bored cast iron sleeve, which is built into the hull, and are suspended from the top of this sleeve by a split clamp or collar fitted into a turned recess near the top of the rudder stock. To renew a rudder all that is necessary is to remove the tiller arm and split collar and let the disabled rudder and rudder stock drop overboard. A new rudder is then shipped up through the rudder stock sleeve and the split collar and tiller arm put on again, all of which can be done in 30 minutes.

Steering Engines

Hydraulic power is used for operating the steering engines, being supplied at 250 pounds pressure by two Knowles special 16-inch by 6-inch by 18-inch duplex pumps, one of which is a spare pump. The steering engine proper consists of an 8-inch single-acting cylinder with the usual leather cups, hydraulic piston packing, and is controlled from the pilot house by a horizontal lever directly connected to a 2-inch fourway plug cock. Fresh water is used, a 7,800-gallon tank being furnished for this purpose. The discharge is led back to this tank.

The boat also supplies the power that lowers the aprons in the slips, connections being made with the hydraulic line from the steering engine, which terminate in valve connections at each end of the boat and which are readily connected to a flexible line from the cylinders on the aprons operating them.

The aprons are heavy steel structures having four tracks, 12-foot centers, the same as the boat. They are 104 feet long, the shore end hinged and the other end floated on a pontoon 45 feet long, 25 feet wide by 11 feet deep. When not used the apron is always up, and to lower it requires but a clamp coupling and the turning of a valve, which is done by the deck hands on the boat and requires no attendant on the aprons whatever.

Propelling Machinery

The main engines operate independent paddle wheels on each side of the boat, each operated by a two-cylinder simple jet condensing engine 60 inches diameter by 8 feet stroke developing 3,000 indicated horsepower at 20 revolutions per minute with 60 pounds boiler pressure.

The cylinders are arranged one on each side of the wheel shaft, the line of motion being inclined 17 degrees with the horizontal. The connecting rods are 18-foot centers with strap gib and key ends; both rods connect with the same crank pin, one of the rods being forked for this purpose.

The valves are of the balanced poppet type, operated by a Corliss valve gear. The steam valves are controlled by an auxiliary cut-off of the releasing hook type, with an air-cushion dash pot on the top of the valve stem to prevent slamming of valves.

The reversing engine has a 9-inch cylinder 30-inch stroke and is located between the two reversing links. The connections are so arranged that when the engines are reversed one link is lowered and the other raised, thus taking advantage of balancing weights.

Although the engines and auxiliaries are located below the main deck, complete control is obtained from the engineers' stand on the main deck.

The engines, including the handling gear and condensers, were built at the Southern Pacific Company's railroad shops at Sacramento, Cal.

Boilers

There are eight Scotch dry back boilers 11 feet diameter by 13 feet long, in 4 units of two boilers each, with a total heating surface of 16,688 square feet. Each unit has a steam chimney superheater 94 inches outside diameter by 15 feet 6 inches long, with a corrugated flue 54 inches inside diameter. Each boiler has 276 3½-inch tubes and two Morison corrugated suspension furnaces

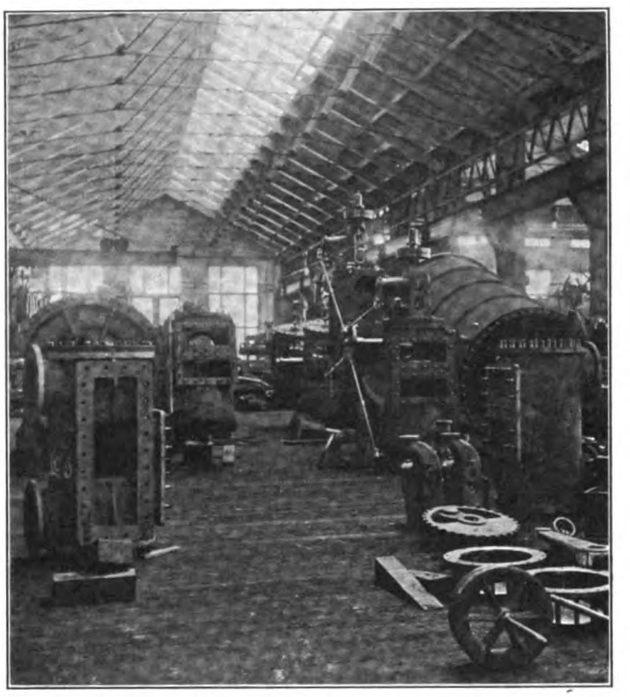

Fig. 11.—View of Main Engines, Being Assembled in the Southern Pacific Company's Shop at Sacramento

48 inches inside diameter. All boilers are located on the main deck on the guard nearly centering on the gunwale line, the two units on the same side of the boat being connected by a 19-inch main steam pipe; and as the boilers are about 100 feet apart the pipe line is made very flexible by swivel elbows at each boiler unit, which takes up all expansion and allows for all sagging or hogging to which the hull may be subjected without injury to the steam line. The boilers are equipped with a steam-atomizing oil-burner system, using a G. E. Witt burner.

Auxiliaries

The auxiliary equipment is very complete, consisting of 27 pumps, as follows:

Four 16-inch by 32-inch by 21-inch vertical single-acting twin beam air pumps.

Four 10-inch by 7-inch by 10-inch vertical duplex boiler feed pumps.

One 10-inch by 7-inch by 10-inch vertical duplex locomotive filling pump.

Four 6-inch by 4-inch by 6-inch vertical duplex oil pumps.

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Eight 4½-inch by 2¾-inch by 4-inch vertical duplex boiler circulating pumps.

Two 14-inch by 8½-inch by 12-inch vertical duplex bilge pumps.

Two 14-inch by 8-inch by 12-inch horizontal duplex deck fire pumps.

Two 16-inch by 6-inch by 18-inch horizontal duplex steering engine pumps.

It is to be understood that the main engine, boilers and auxiliaries are in duplicate on each side of the boat—that is, each side of the boat has an entire independent steam plant. The air pumps are located on each side of a jet condenser and are of such size that either can maintain a vacuum of 19 inches, if for any reason one of the pumps should become disabled.

As the injection water is forced in by atmospheric pressure a 5-inch Dean vacuum breaker has been attached to the condenser to prevent the flooding of the condenser and endangering the engines, should both air pumps for any reason stop at the same time. The air pumps are controlled from the engineer's stand on the main deck. To simplify the piping the air pump discharges into a hotwell or "dump," consisting of a cast iron well 28 inches diameter and 9 feet high with a 12-inch outlet to the bottom of the boat. Although the boiler feed pumps are located in the hold complete control of them is obtained from the fireroom by manipulating the boiler check, the pumps being regulated by a Williams pressure regulator controlling the steam to the pumps by the pressure in the discharge line.

Each boiler is fitted with an independent boiler circulating pump, which is also connected to suction line of the inspirators and can thus be used as an auxiliary boiler feed. Each boiler has also a No. 50 stationary type Hancock inspirator.

The exhaust steam from the auxiliaries is utilized for heating the feed water, a Wainwright corrugated tube feed water heater being used for this purpose.

Fresh water for the galley and general purposes is supplied by gravity from two 2,000-gallon tanks located on the top of the superstructure.

Paddle Wheels

The paddle wheels are of the radial type, each with four cast steel wheel flanges of very light design keyed to a 20-inch diameter wheel shaft. The wheel is 28 feet diameter over buckets and has 3-foot, 4-inch dip when light-loaded. There are 20 buckets 3¾ inches by 28 inches wide by 16 feet long, which are bolted to the wheel arms with four ¾-inch stirrups The arms are 4 inches by 15¾ inches of Oregon pine.

Current for all electrical requirements is furnished by two 25-kilowatt turbine generating sets located on the main deck. There is a 13-inch General Electric searchlight projector for each pilot house and the usual side lights, which are worked directly from the telltale board in the pilot house.

The main deck is illuminated with 20 vapor-proof 13-inch Crouse-Hinds Company reflectors. Six of these lights nearest the pilot house at either end are under the control of the pilot house.

The electric fixtures in the restaurant, bar and waiting rooms are equipped with XE Holophane reflectors. The engine and boiler rooms are equipped with vapor-proof conduits. Each of these rooms is wired in two circuits, the lights for the general lighting being alternated. At the steam gages and water glasses there are lights from each circuit, so that in case of a fuse blowing out in one circuit there will always be a light at these important points.

The compartments below deck, of which there are 45, are lighted by lamps placed in vapor-proof globes and in such compartments as have valves, steering gear, rudders, etc., there are watertight plug boxes. The engine and boiler rooms also have watertight plug boxes, which arrangement is such as to permit a number of portable lights.

There are four telephones, connected in multiple, from the pilot house to the engine rooms, also an electric call-bell system from pilot house to pilot house. There are also electric return calls for filling oil tanks for the purpose of signaling the attendant at the oil filling valves. Bell signals are always exchanged before filling the oil tanks to ascertain if everything is working properly, as the tanks might be flooded if bells should fail. There is also a push button at the side of the house at each quarter of the boat for man-overboard signals.

The electric fire-alarm system consists of 12-inch Faraday electric gongs in each engine room and directly under each pilot house. All wiring on this boat conforms to the National Electric Code standard rules.

Interior Views of the Great Northern

Passenger Accommodations of the Luxurious Steamers of the Great Northern Pacific Steamship Company

Supplementing the illustrated description of the design and construction of the 23-knot turbine-driven steamships *Great Northern* and *Northern Pacific*, published in our December, 1914, issue, we are now able, through the courtesy of the Great Northern Pacific Steamship Company, to publish in the following pages several views of the passenger accommodations of these magnificent vessels.

The *Great Northern* and *Northern Pacific* are sister ships, differing only in minor details. They were built by the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., and classed A-100 in accordance with the rules of British Lloyd's and also equipped to pass the laws now in force by the United States Steamboat Inspection Service. To recapitulate, the main particulars are: Length overall, 524 feet; length between perpendiculars, 500 feet; beam, 63 feet; depth, molded to A deck, 50 feet 8 inches; draft, full load, 21 feet; deadweight carrying capacity, 2,185 tons; shaft horsepower, 25,000; speed, 23 knots; passengers, first class 550, second class 108, third class 198; total passengers, 856; crew, 198; total number of persons on board, 1,054; gross tonnage, 8,255.

Few modern passenger ships of the same tonnage and type can boast of more commodious promenade decks or of more tastefully decorated or conveniently arranged public and private rooms. As can be seen from the photographs published in this issue, and from the plans previously published, these vessels are in every respect entitled to the popular designation of "floating palaces."

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Fig. 1.—Corner of the Writing Room

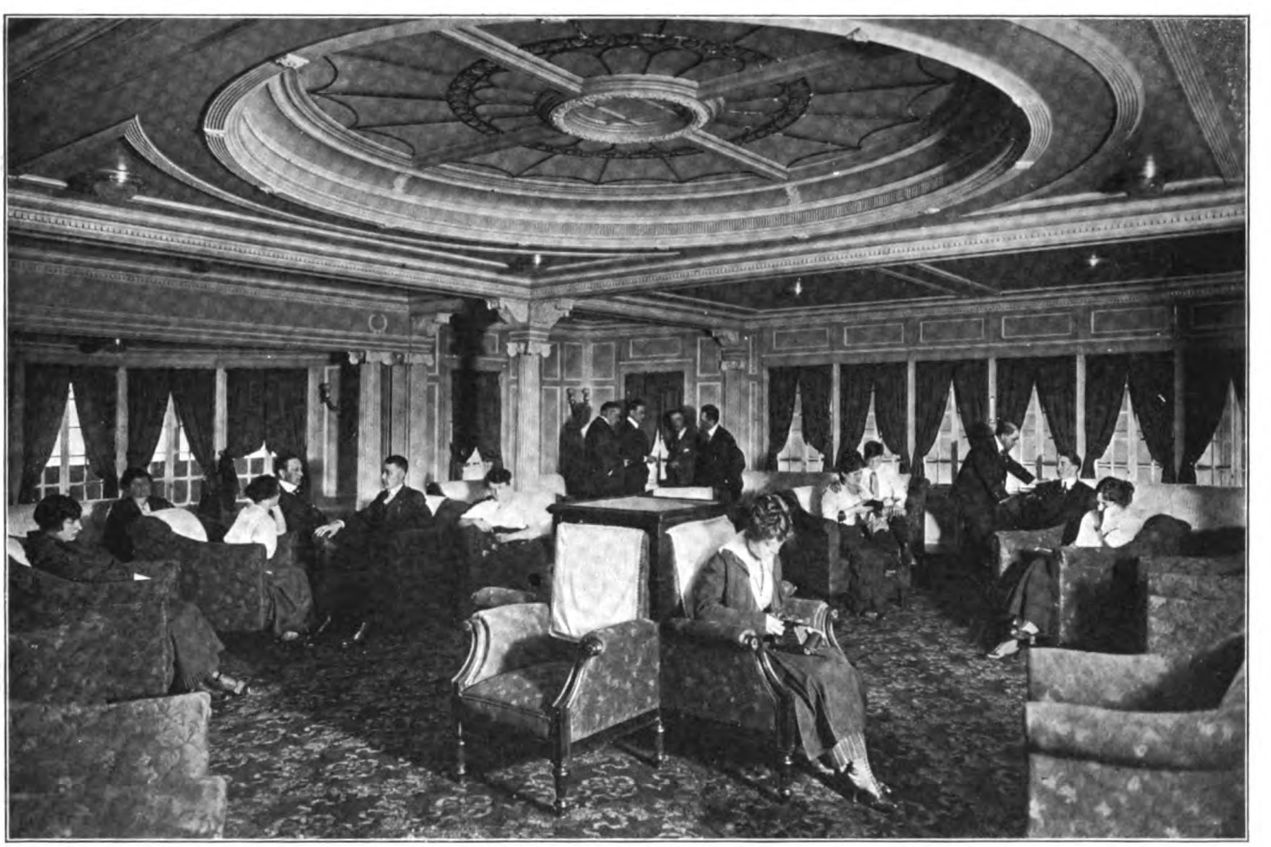

Fig. 2.—Observation Parlor

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Fig. 3.—Colonial Dining Room

Fig. 4.—Private Suite

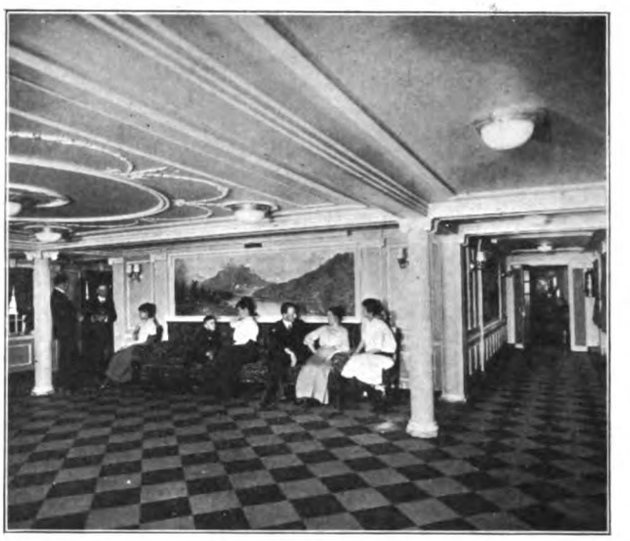

Fig. 5.—Main Companionway

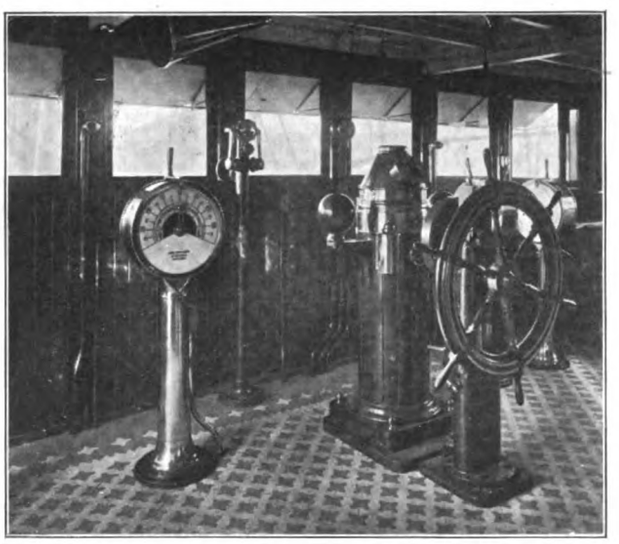

Fig. 6.—Wheel House

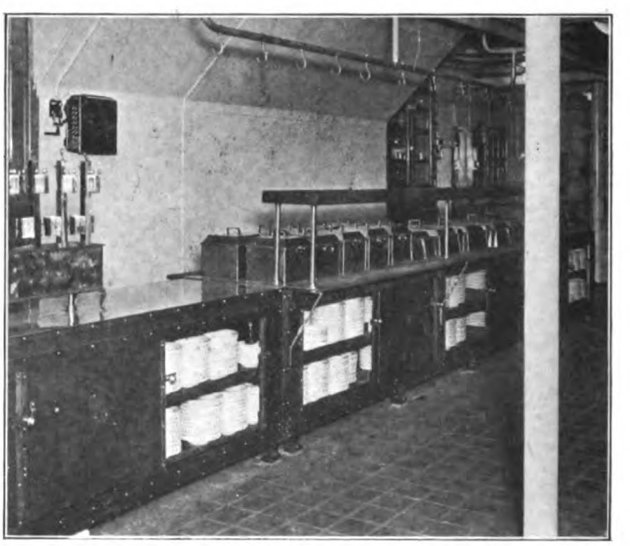

Fig. 7.—Pantry

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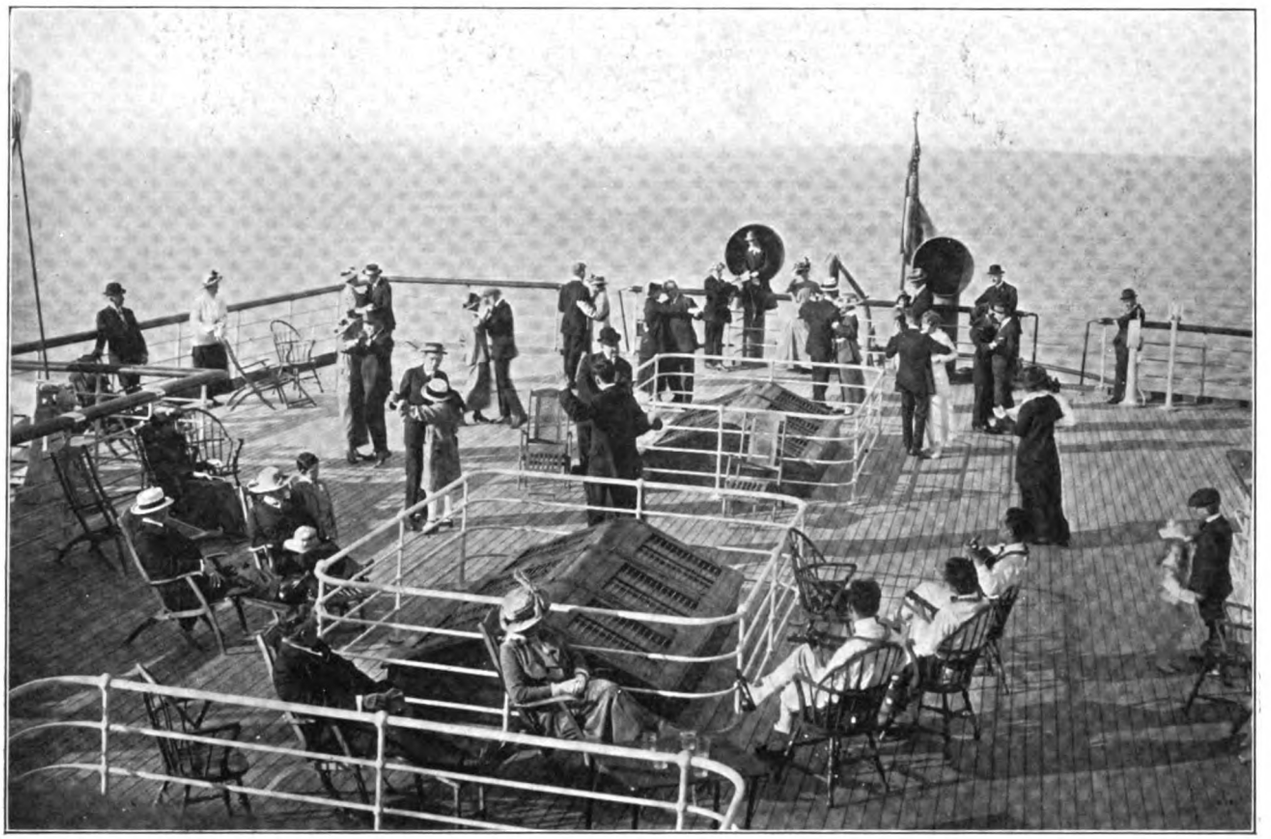

Fig. 8.—Dancing on the Upper Deck

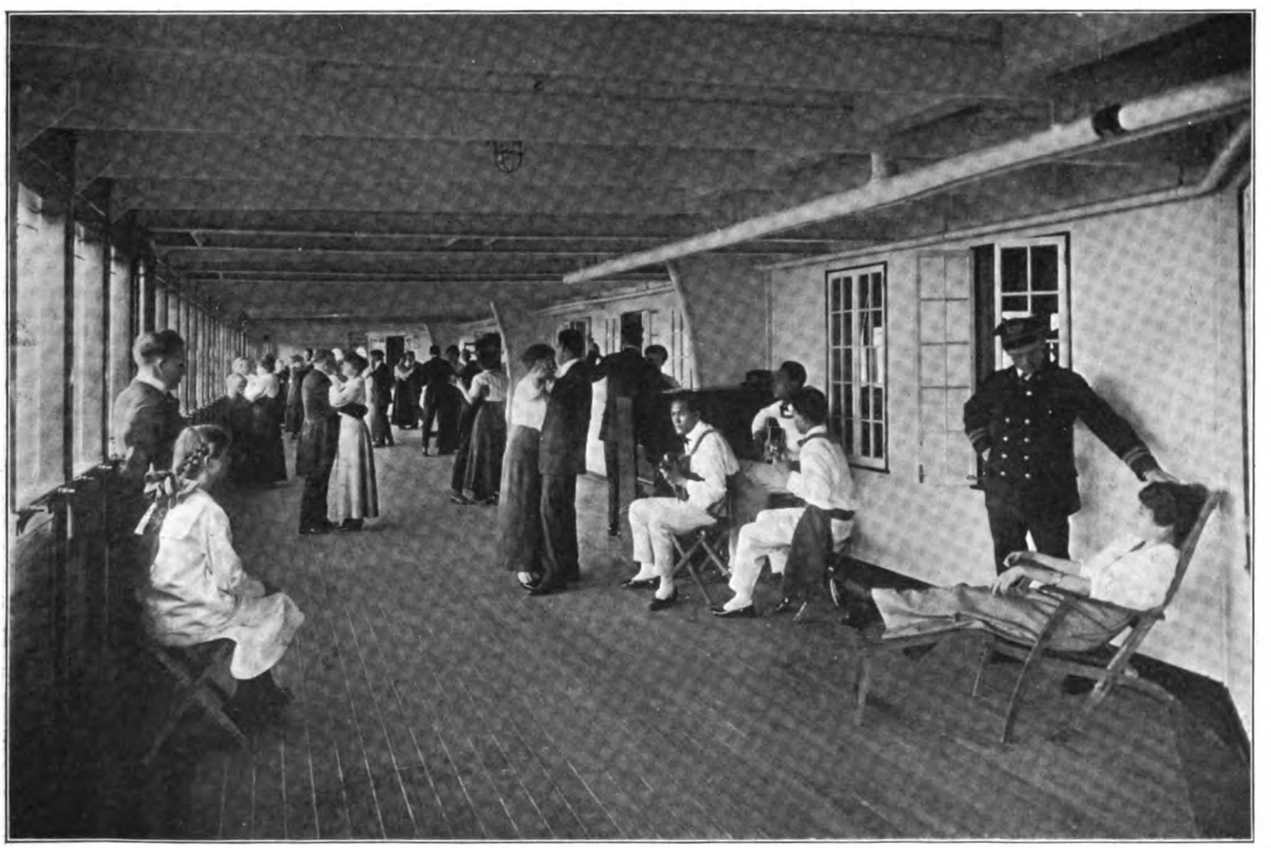

Fig. 9.—Glass Enclosed Promenade

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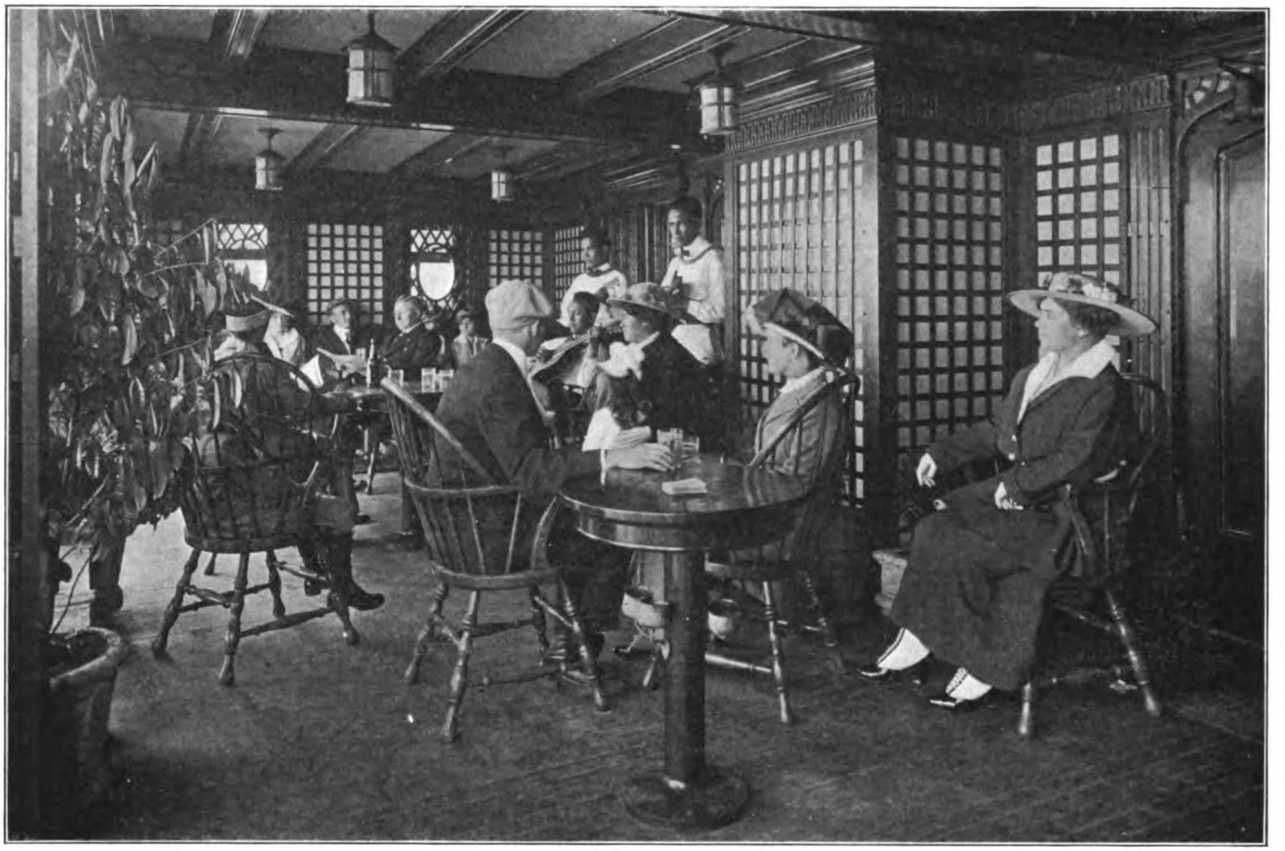

Fig. 10.—Palm Garden Veranda

Fig. 11.—First Class Smoking Room

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Modern Submarines in War and Peace—III

Early Development of the Submarine in Germany, France and Italy—Modifications of Original Inventions

BY SIMON LAKE *

Some incorrectly informed writers of books and magazine articles have, through their lack of complete information, given the credit of inventing and developing this seagoing type of submersible to the Krupps of Germany, to former Naval Constructor Laubeuf of France, or to former Naval Constructor Laurenti of Italy. For the purpose of giving a correct history of this development, perhaps I may be pardoned and not considered egotistical if I mention a few facts in connection with the development abroad of this type of boat.

On April 2, 1897, I applied for a patent on a combined surface and submarine vessel, the specifications of which began as follows:

"This invention relates to a *combined surface and submarine vessel* and may be employed either as a torpedo boat or for freight and general cruising purposes, or for submarine work of all kinds.

"It has for its object, first, to combine with a submarine vessel cylindrical in cross-section a superstructure built upon the submarine vessel and affording a large deck surface, buoyancy, and a high freeboard for surface navigation, the space between the submarine vessel and the superstructure being adapted to be filled with water when the vessel is submerged, and thus rendered capable of resisting the pressure of the water, etc. . . ."

A patent was granted in due course with fifty claims, and according to the records of patent offices throughout the world this is the pioneer patent covering this form of vessel.

When Krupps took up the matter of constructing submarines for the Russian and German governments, they took up this type of vessel as offering greater opportunity for development than the diving type. A contract was drawn with their directors for the construction of the "Lake" type of boat, which they accepted by wire. This contract covered their erecting a plant in Russia for the manufacture of "Lake" submarines on a division of profits and on a royalty basis in Germany. It also covered my employment by them in an advisory capacity. I was living abroad at the time and the papers were sent to my directors in America for their approval.

In the meantime I had submitted to them various plans of submarines, copies of my patents, and even my secret data, including copies of patents pending, all to enable them to go ahead, as I considered the agreement settled by their wire of acceptance. I had also advised them how

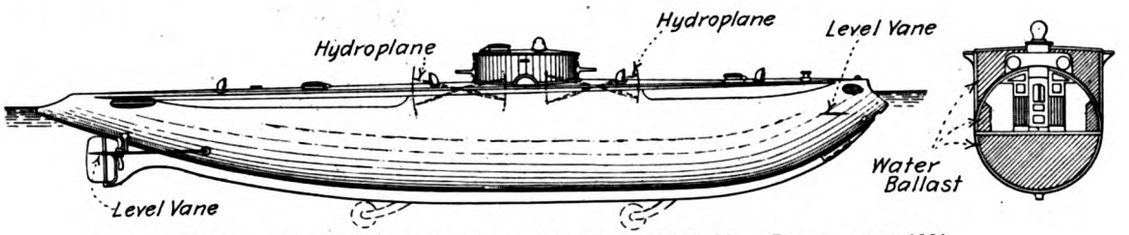

Fig. 24.—Plans of Lake Submarine, as Submitted to U. S. Navy Department in 1901

Mr. Lake's company built several vessels of this type for foreign governments and with slight modifications many of its general features have been adopted in the latest submarines in Germany, Italy, Russia, Austria and France.

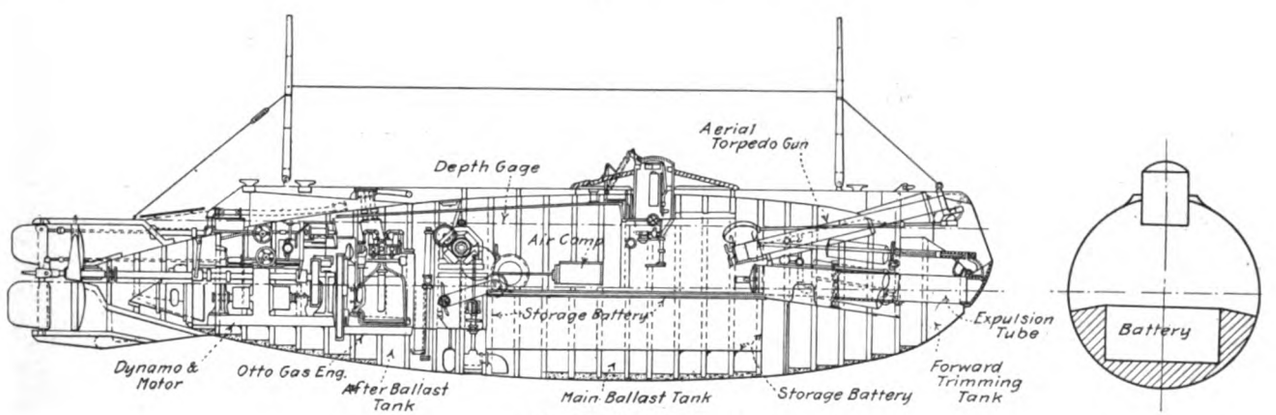

Fig. 25.—The *Holland*

This vessel, while holding to the same general principles of construction and method of control as used in the *Plunger*, was much better proportioned and had a much better distribution of weights. It was her performance that led the House Naval Committee in 1900 to authorize the construction of additional submarines of the Holland type. Her armament consisted of one torpedo tube forward and an aerial torpedo gun for firing aerial torpedoes, designed to be used somewhat on the same principles as used on the gunboat *Vesuvius*.

* Member of Institution of Naval Architects (England), Schiffbautechnische Gesellshaft (Germany), Society of Naval Architects and Marine Engineers (United States) and American Society of Mechanical Engineers.

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to overcome certain difficulties in boats which they then had under construction for the Russian Government at their Kiel plant, the Germania Werft.

Before I succeeded in getting the power of attorney from my directors in America authorizing me to sign up the agreement, the great industrial revolution started in Russia (immediately after the Russo-Japanese war) and the Krupps informed me that, owing to that fact, they had reconsidered their idea of going into Russia and withdrew from the arrangement. Their attorney there informed me that on looking up the patent situation they found that "I had not protected myself in Germany and that they were free to build 'Lake type' boats in Germany and expected to continue to do so."

This was true, for, like most pioneer inventors, I had not succeeded in securing sufficient capital to finance and protect my fundamental inventions in all countries, which would have involved very large amounts in taking them out and paying the yearly tax.

So much for Germany.

The Conference in Rome

In 1905, while residing in Berlin, Germany, I was called to Rome and sat three days with a commission appointed by Admiral Mirabello, at that time Italian Minister of Marine, regarding their construction of submarines. I then learned that the Italian Government had started on a plan of building submarines of substantially my type, that they had several under construction at their Venice Arsenal after the design of Major Laurenti, a naval constructor, that certain difficulties which they explained to me had arisen, and that they had not succeeded in getting any of their boats to function satisfactorily submerged. I came to the conclusion that their trouble was due to lack of longitudinal stability and advised the Commission how to increase this, and shortly afterwards I was advised that they had corrected their trouble and that the boats there worked satisfactorily.

Major Laurenti, at this time, resigned from the Italian navy and became affiliated with the Fiat Company, and has designed quite a large number of successful submarine boats, all of which have buoyant superstructures and are designed to operate on a level keel by the use of hydroplanes. These boats are of the "Lake type" as far as invention goes.

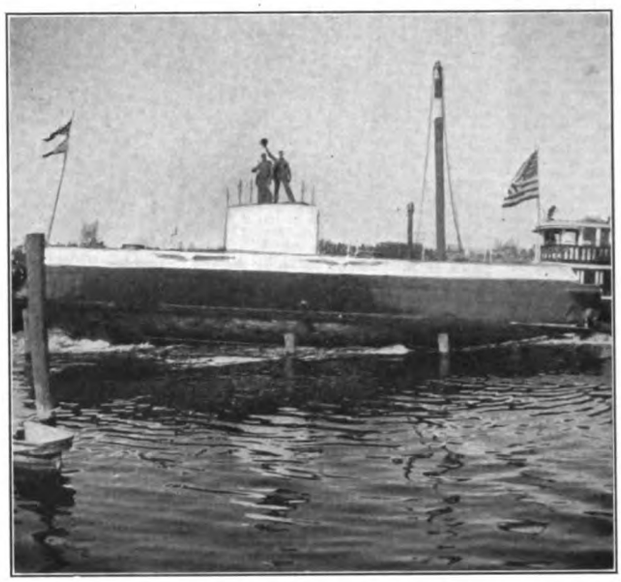

Fig. 27.—Launch of the *Protector*. Built in Bridgeport, Conn., in 1901-1902, Now in Vladivostock, Russia

There is a difference, however, between invention and design. Invention introduces a new method, new principle, or a new form of construction, to accomplish a certain purpose in a new way. Many modifications of design may be made which do not involve invention.

As an illustration, on August 14, 1907, Major Laurenti applied for a United States patent on a submarine or submersible boat in which the attempt was made to secure a patent on slight variations of design over the "Lake type."

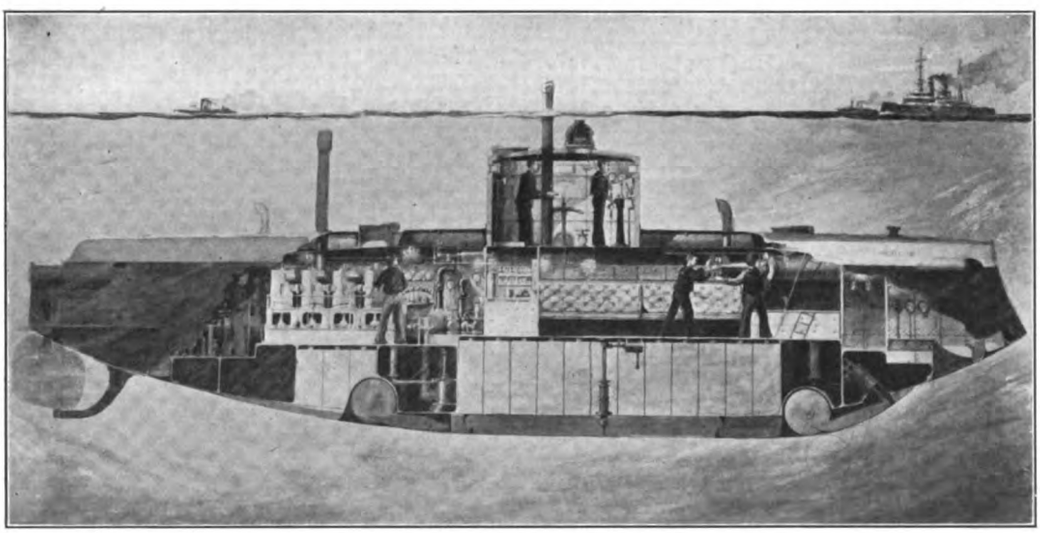

Fig. 26.—The *Protector* (Lake Type, 1901-1902)

The patent office records show that many amendments were made and hearings held in the endeavor to evade the foundation patent of Lake, No. 650,758, which was applied for April 2, 1897, over ten years before Laurenti applied for a patent. The patent office consistently and persistently held that the slight difference in design did not involve invention over "Lake."

After arguments and hearings, extending over a period of over three years, Major Laurenti was finally obliged to accept a patent restricted to details of construction, most of which were in themselves not new to me, as they had

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already been used in various modifications of my inventions and consisted in such changes as would naturally be worked out by any good hull or engine draftsmen while developing the designs of a vessel.

Our patent laws are too free in allowing the grant of over 1,100 claims covering a few fundamental inventions, some of which cover details of construction for which I should not have been forced to seek protection.

All original inventors complain of this system. I know of several instances where patents on modifications of

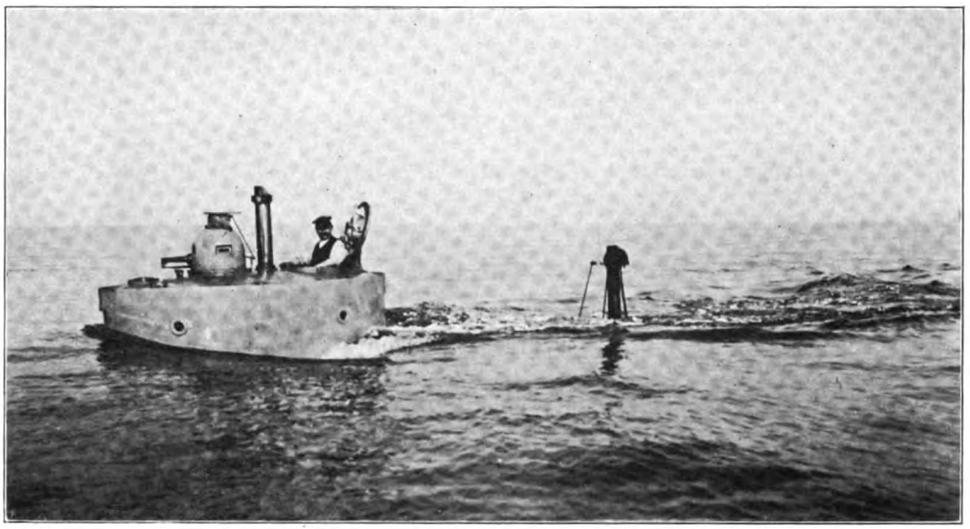

Fig. 28.—The *Protector* Running, in Condition for Instant Submergence

Her conning tower is being held partly above the surface by her "hydroplanes" being "set" so as to "lift" instead of submerge. This photograph shows the remarkable steadiness and reliability of this early hydroplane level keel boat and the confidence of her crew in navigating in this manner.

patents on modifications of design while fundamental patents are still in force. This works great hardship on original inventors, forcing them to take out a great many patents on features of design rather than on invention. I have taken out nearly 100 United States patents with design have been granted, which modifications have been in common use for several years by others, but were only considered as a design and not as an invention. Then some designer hits on the same arrangement and considers he has made an invention and applies for and takes out a

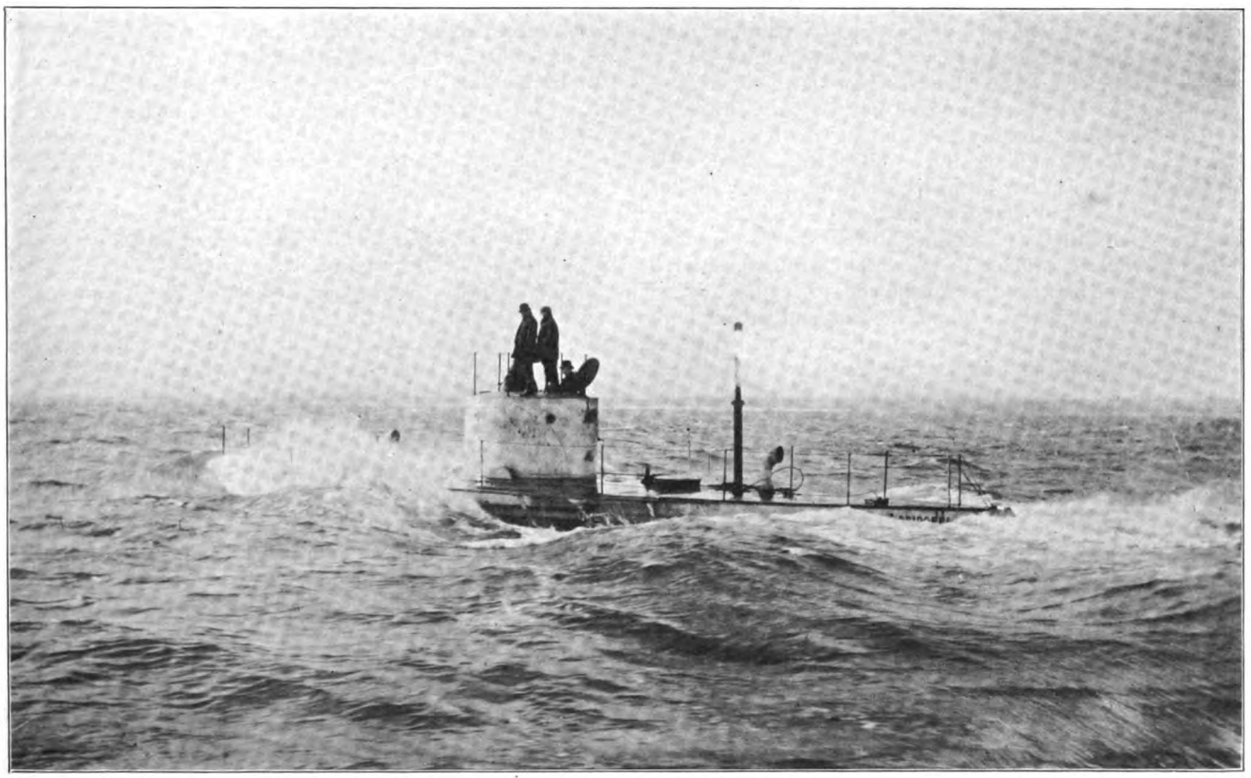

Fig. 29.—The *Protector* Running in Long Island Sound in 1902 in Rough Weather

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patent which has already been in common use but has been looked upon purely as a design by its originator rather than an invention. Then the original designer may be hauled up before the courts and put to great expense to prove that it was in prior use as a design.

While Captain Laubeuf and the Krupps have taken out several patents on detail mechanisms for use on submarine boats, they have never, as far as the author is aware and the public patent records show, attempted to claim to be the original inventors of the type of submarine with buoyant ship-shaped form of hull consisting of a pressure resisting body surmounted by a watertight non-pressure resisting body which gives suitable form for surface speed and seaworthiness, which is the principal characteristic of vessels built by them. I feel, therefore, that certain misinformed authors should, in the interest of fact, correct their statements if they issue new editions of their work or write further on the development of the submarine.

During the years of practical experimental work with the *Argonaut*, Mr. Holland continued in his efforts to get the *Plunger* (building under the 1893 appropriation) in shape for submerged trials, but without success.

Why the Plunger Failed

The large steam installation, 1,600 horsepower, was largely responsible for this. As I remember, there was only about 18 inches between the main engines, with large steam supply and exhaust pipes overhead and under foot. These engines were designed to run at over 400 revolutions per minute. The boiler was located nearly in the center of the vessel and so nearly filled the ship that there was barely room between the top of the boiler and ship to creep from "forward to aft."

The heat was so intense that the trial crew found it impossible to live in the boat, so, for their full power dock trials, valve stems were run up through the deck to enable the engines to be started from there. Arrangements were also made to take the indicator cards from the deck.

She was also fitted with a heavy armored conning tower, as per Mr. Holland's description previously quoted. This combined with the high position of the boiler and engines, combined with her cigar-shaped form (which gives a diminishing water plane), reduced her stability almost to zero. I was informed when the attempt was first made to start up one of her engines, her stability was so little that the turning effort on her propeller shaft nearly caused her to "turn turtle," and that she rolled over on her side to such an extent that the conning tower struck the dock stringer. The constructor at the Columbian Iron Works then put heavy chains on her so she could not turn over.

Every inducement was made to the Holland Company to enable them to make this vessel satisfactory, as Congress in 1896 authorized the Secretary of the Navy to contract for two more "submarine torpedo boats of the Holland type, *Provided* that the Holland boat now being built for the Department shall be accepted by the Department as fulfilling all the requirements of the Contract."

She was finally abandoned in 1900 without ever making a submerged run or fulfilling any of her guarantees of performance under which the award was secured.

Mr. Holland as early as 1897 must have concluded that the *Plunger* was destined to failure. In fact, no submarine, even up to the present day, has ever equaled the performances guaranteed under the *Plunger's* contract. He therefore built a much smaller boat, called the *Holland*. This vessel was fitted with internal combustion engines instead of steam, and was finally accepted by the United States Government in lieu of the *Plunger*, and placed in commission in 1900.

She was the first submarine torpedo boat to go into commission in the United States Navy. Her characteristics were: Length, 53 feet 4 inches; beam, 10 feet 3 inches; displacement, 64 tons surface, 75 tons submerged; power, internal combustion engines, 50 horsepower; surface speed, 6 to 7 knots, claimed; submerged speed, 5 knots claimed. The only official report I have seen gave her a surface speed of 5⅔ knots. I believe she was purchased by the authority of the Act of June 7, 1900, which read as follows:

"The Secretary of the Navy is hereby authorized and directed to contract for five submarine torpedo boats of the Holland type of the most improved design, at a price not to exceed one hundred and seventy thousand dollars (£35,000) each: Provided, That such boats shall be similar in dimensions to the proposed new *Holland*, plans and specifications of which were submitted to the Navy Department by the Holland Torpedo Boat Company, November twenty-third, eighteen hundred and ninety-nine."

The United States was, therefore, at the beginning of the twentieth century, fairly launched on a policy of submarine boat construction, and other governments rapidly followed suit. France had, in the meantime, brought out two new boats, the *Morse*, 1898, and the *Narval*, after the designs of M. Laubeuf, launched October 26, 1899. The *Gustave Zede* had also been modified by adding hydroplanes so that she became controllable submerged.

The *Morse* was 118 feet long by 8 feet 3 inches beam, with a displacement of 136 tons of about the same type as the *Gustave Zede*. The *Narval* was 111 feet 6 inches in length by 12 feet 4 inches beam, 106 tons surface displacement and 168 tons submerged. She was, like the author's 1893 design, a double hull vessel controlled by hydroplanes. She was fitted with "Drezewiecke" apparatus for carrying and discharging torpedoes, two of which were carried on either side.

First French "Submersible"

The *Narval* was a successful type and appears to have been the first French naval vessel to adopt a shipshape outer hull of lighter plating. She was also, as far as my records show, the first French boat to be fitted with two motive powers, viz., steam for surface work and electricity for submerged work. To distinguish her in these particulars from the purely electric boats of cigar-shaped form, like the *Gustave Zede* and *Morse*, Mr. Laubeuf called her a submersible.

Very little was known about the French boats at this time (1900), as their method of construction and experiments were kept secret, but enough information leaked out as to their reported success to cause the British public much uneasiness and they began to demand that their Admiralty should also take up the development of the submarine. No one had, so far, evolved a satisfactory type in England, so when the fact became known that the United States Congress had made an appropriation for five *Holland* boats, the British public became still more insistent that they should also have submarines.

About this time, so the author was informed by Sir William White, who was then chief constructor of the British Navy, Lord Rothschild brought to him Mr. Isaac L. Rice, president of the Electric Boat Company, who controlled the Holland patents and who offered to build duplicates of the United States boats for England. Sir William thought this gave the Admiralty the opportunity to satisfy the public demands and to meet the French, their hereditary enemy (this was before the establishment of the "Entente Cordial"), in their development of the submarine, consequently an arrangement was made for the manufacture of this type of vessel for England by the Vickers

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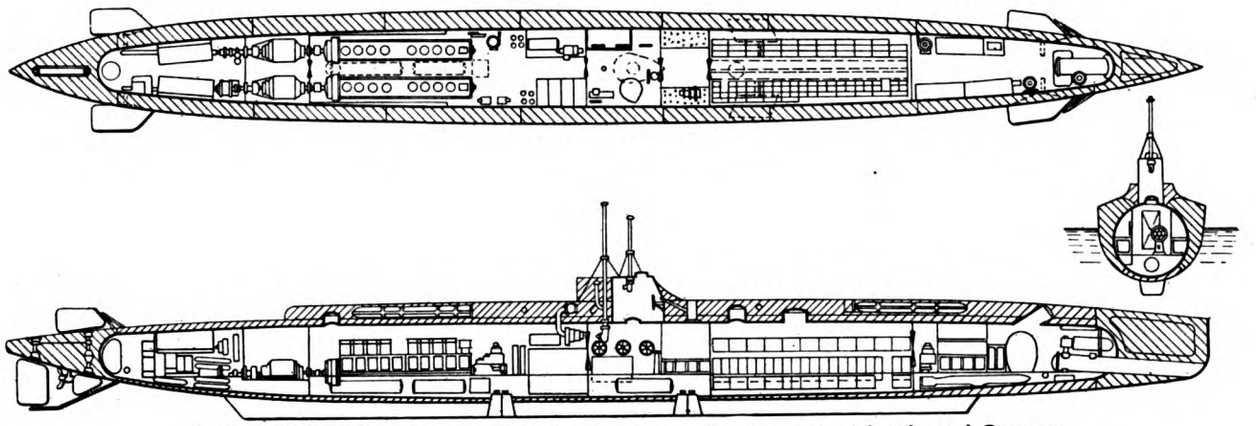

Fig. 30.—Modern French Submarine of Laubeuf Design, Constructed by Schneider and Company

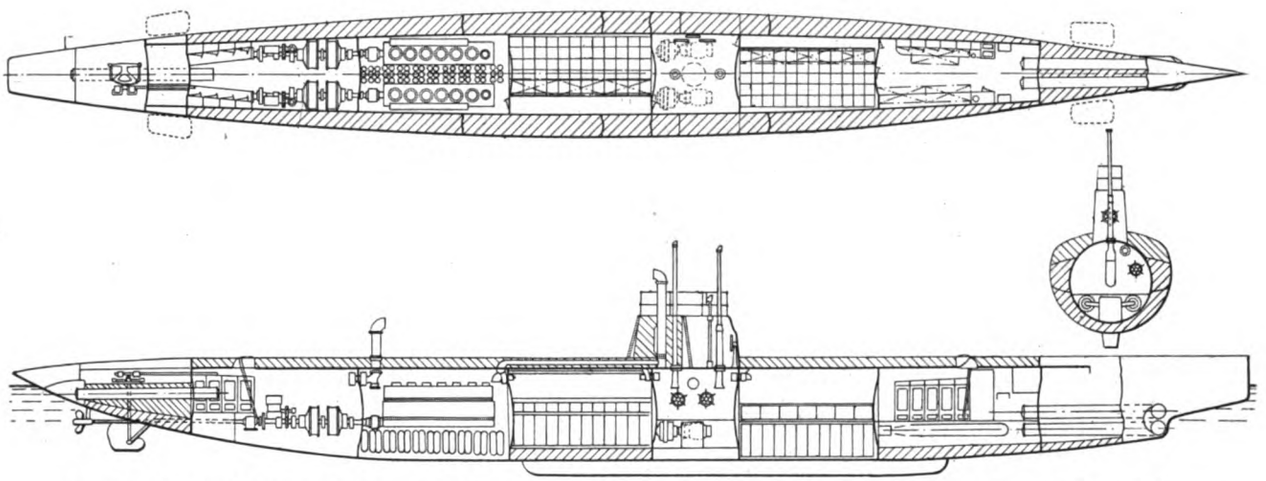

Fig. 31.—Modern Italian Submarine—Fiat Construction—Laurenti Design. Vessel of the Double Hull Buoyant Superstructure, Hydroplane Controlled Type

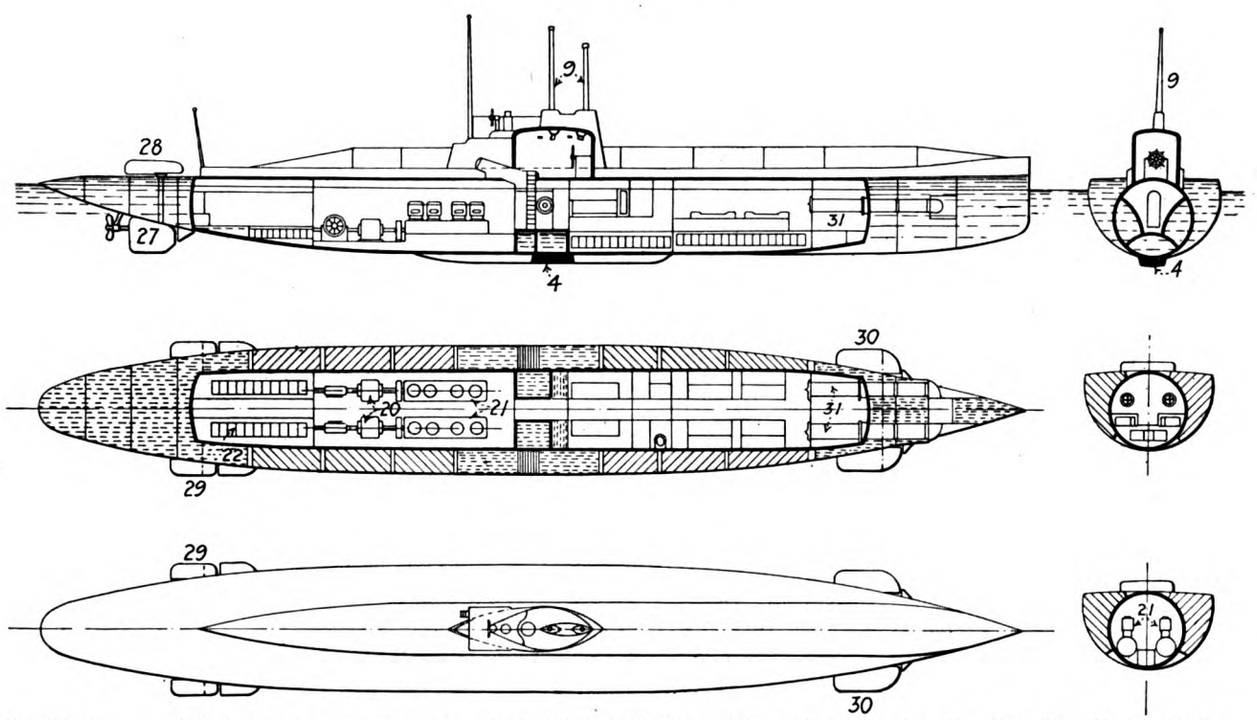

Fig. 32.—German "U" Boat—Krupp Design. 27 and 28, Vertical Rudders; 29 and 30, Hydroplanes for Controlling Depth of Submergence; 9, Periscopes; 21, Engines; 20, Motors; 22, Storage Batteries; 4, Drop Keel; 31, Torpedo Tubes

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Company and an agreement was drawn, so he informed me, giving "Vickers" an exclusive monopoly of building submarines for the British Navy for a period of ten years, the consideration being that they should have available for the use of the British Admiralty all the details of the development work of the Electric Boat Company in America. This, plus their own experience and development work in England, which should be kept secret, should enable them (England) to keep on an equal footing with France.

Sir William informed me that he thought this had been a mistake in policy, as it had deprived the government of the opportunity to secure improvements that had been developed by other inventors and builders who had made greater progress on independent lines.

England, therefore, started to build her first submarines, known as the "A" type. These were practically duplicates of the United States *Adder* and *Moccasin* type, now also designated as "A's" Nos. 1 to 7. England has been particularly unfortunate with this class of submarine, several of them having plunged to the bottom with the loss of their crews.

The majority of the British and American boats are developments from the original *Holland* of Mr. Holland's design. Increasing the stability, greater subdivision of ballast compartments, refinements in steering gear, and the addition of hydroplanes forward have enabled Mr. Holland and his successors to produce submarines that operate very well. These boats, however, with only one pair of forward planes, still require constant manipulation of the horizontal rudder to control them when submerged. This rudder, controlled by power gear, is very effective and will, by expert manipulation, hold the submarine to practically even depth, the only danger the writer can see is that the diving rudder gear might fail to function after it is set in the diving position, in which case the vessel might continue diving until she struck bottom or reached a depth great enough to cause her to collapse.

The modern submarine, therefore, as built and used in all the world's navies, owe their final success to principles of construction and control devices invented and introduced into the art by two American inventors.

(*To be continued.*)

Notes on the Conversion of Cargo Vessels into Bulk Oil Carriers—VI

BY F. K. RUPRECHT *

PUMPING SYSTEMS

The oil pumping lines and ballast lines must not be connected in any way. No ballast pipes will pass through oil compartments, nor shall oil pipes be led through the engine or boiler rooms; that is, the oil system for the forward part of the vessel will be entirely independent of that for the after part.

A 10-inch or more diameter lap-welded steel pipe will be fitted on each side of the centerline bulkhead throughout the tanks and cofferdams. Eight-inch suctions with bell mouths will be led from this pipe at the after end of each tank and cofferdam. These bell mouths will be clear of the bottom plating by about ½ inch. Limber holes will be cut in all floors and in the margin plate to allow the oil to flow to the suctions. An 8-inch diameter crossover pipe will be fitted in each tank and cofferdam connecting the two main lines. This enables any tank to be pumped through any line. A 10-inch master valve will be fitted just forward of the bulkhead in each tank and an 8-inch valve on the suction pipe and another on the crossover pipe. The stems of these valves will be led up to the upper or weather deck, where they will be fitted with hand wheels. If necessary, bevel gears and brackets will be fitted to valve stems to clear hatches or other obstructions. A bushing will be provided at the tank deck and an oiltight stuffing box at the upper deck. If the stems pass through the shelter deck, a watertight stuffing box will be fitted. All these valves will be double-seated gate valves with a stationary stem.

On the 10-inch main line an expansion joint will be fitted in each tank. Where these pipes pass through the bulkheads oiltight fittings will be installed. These will usually be the shipyard's own standard. The two main lines will lead into a suction and discharge manifold in each pump room where two independent horizontal steam pumps will be installed. One of these will be about a 14-inch by 12-inch by 14-inch and the other an 8-inch by 6-inch by 8-inch. The piping will be so arranged that either pump may be used for any purpose. A filter will be installed in duplicate and piping arranged so that oil can be filtered when discharging or loading. A by-pass will be arranged so that the filters may be cut out. The main sea valves for ballast will be fitted in the cofferdams under the pump room flat and they will be operated from there.

The discharge piping will lead to the weather deck and will be arranged to discharge on either side of the vessel. A line will be fitted along the deck from the discharge line of the after pump room to that of the forward, so that cargo may be discharged from the most convenient place. This connecting line is best made portable, or its tightness may be impaired or the flanges broken by the movement of the vessel amidships when in a seaway.

The steam lines will be led from the main and auxiliary boilers to each pump in the pump rooms, and the exhaust lines will be led to the main and auxiliary condensers or to the steam exhaust tank. A deck connection must be arranged so that shore steam can be used.

A small steam pump will have to be installed forward to pump out the forward dry hold and the peak tank. A connection should also be made to the forward cofferdam to take care of the water ballast in this space. A sea valve and a discharge connection will be fitted to the ship's side. The most convenient location for this pump will be on the top of the peak tank. The steam will be taken from the deck steam line to the windlass and the exhaust will be through this same system.

In most cases it will be found advisable to install a similar pump in the after end of the tunnel to take care of the water in the tunnel, after dry hold and peak tank and the ballast in the cofferdam. A sea valve and overboard discharge must be provided for this pump. The steam will be taken from the deck line through the after access trunk. In some cases the tunnel, dry hold and peak tank may be handled by the ballast pumps in the engine room through old ballast lines to these compartments through the tunnel. This arrangement will usually be passed by the registration societies, but the former is the better.

If the 'tween decks are used as summer tanks, sluice valves must be arranged to allow the oil to drain into the main tanks for pumping. Sometimes an independent pumping system is provided, but in any case provisions must be made for filling them.

Engine and boiler room bilge and ballast systems will be retained and arranged to suit the new conditions.

* Associate Member Society of Naval Architects and Marine Engineers.

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If the 'tween deck spaces are used for cargo or coal, arrangements will be made for pumping them by means of a hand pump on the upper deck. Rose boxes will be fitted in each compartment with a pipe to the upper deck suction manifold which will be connected to the pump suction chamber.

A sounding pipe will be provided in each tank and cofferdam. These pipes will be run up to a height of 12 inches above the upper deck and be fitted with a brass-screwed plug, properly engraved. If desired, these pipes may be carried up to the shelter deck, where a deck plate will be fitted.

Steaming Out Arrangements

Arrangements must be made for steaming out the tanks and cofferdams for cleaning or in case of fire. This is best made a permanent system because a hose line may fail just when needed and is always a source of trouble. The best arrangement is to provide a special steam line from the boilers run along the weather deck with connections to each tank, cofferdam and pump room through the deck or hatch coaming. A quick opening gate valve operated by a lever will be fitted at each branch on the top deck, so that filling a tank with steam is only the work of a few seconds.

Gas Pipes

A copper pipe will be led from the coaming of each oil hatch and cofferdam hatch to a main line running along the upper deck. This line will be carried up each mast to a height clear of the running lights to form a gas and vapor escape, and to prevent a partial vacuum being formed in any tank while pumping before the hatches are opened up. The top of this pipe is to be covered with fine wire gauze.

Ventilation

Each side of the cofferdams will be ventilated by a cowl ventilator covered with fine wire gauze to prevent fire. These ventilators must be arranged to act both as a down-take and up-take.

The pump rooms will be ventilated as noted under that heading.

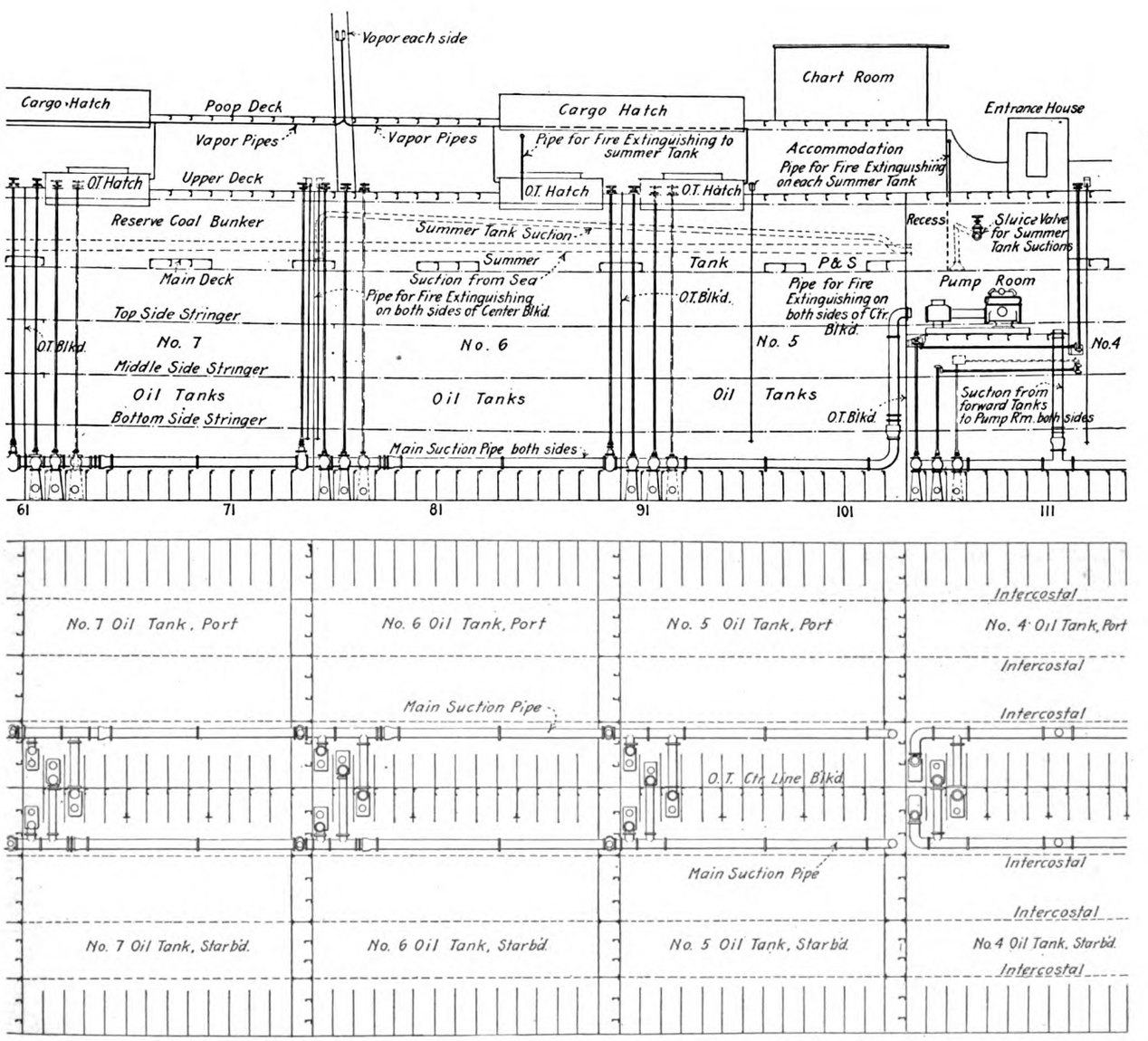

Fig. 18.—Arrangement of Main Cargo Pump Lines in Tanks

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The tunnel will be ventilated through the access trunks, the foremost one being fitted with down-take cowl and after one with an up-take cowl.

The forward and after dry holds will be ventilated by the ordinary means, and the 'tween decks alongside of the expansion trunk, if used as coal bunkers, must also be fitted with ventilators. In this case a down-take ventilator will be fitted at the forward end of each compartment and an up-take at the after end. These ventilators must in all cases be capable of battening down watertight.

In a shelter deck vessel it is very advisable to build gas-tight trunks around the oil hatches on the upper deck. In this way the entire shelter 'tween decks are kept clear of dangerous gases. This 'tween decks space outside of the trunks will be ventilated by the ventilators as already fitted in the vessel. This space outside of the trunks can be used for coal on long voyages.

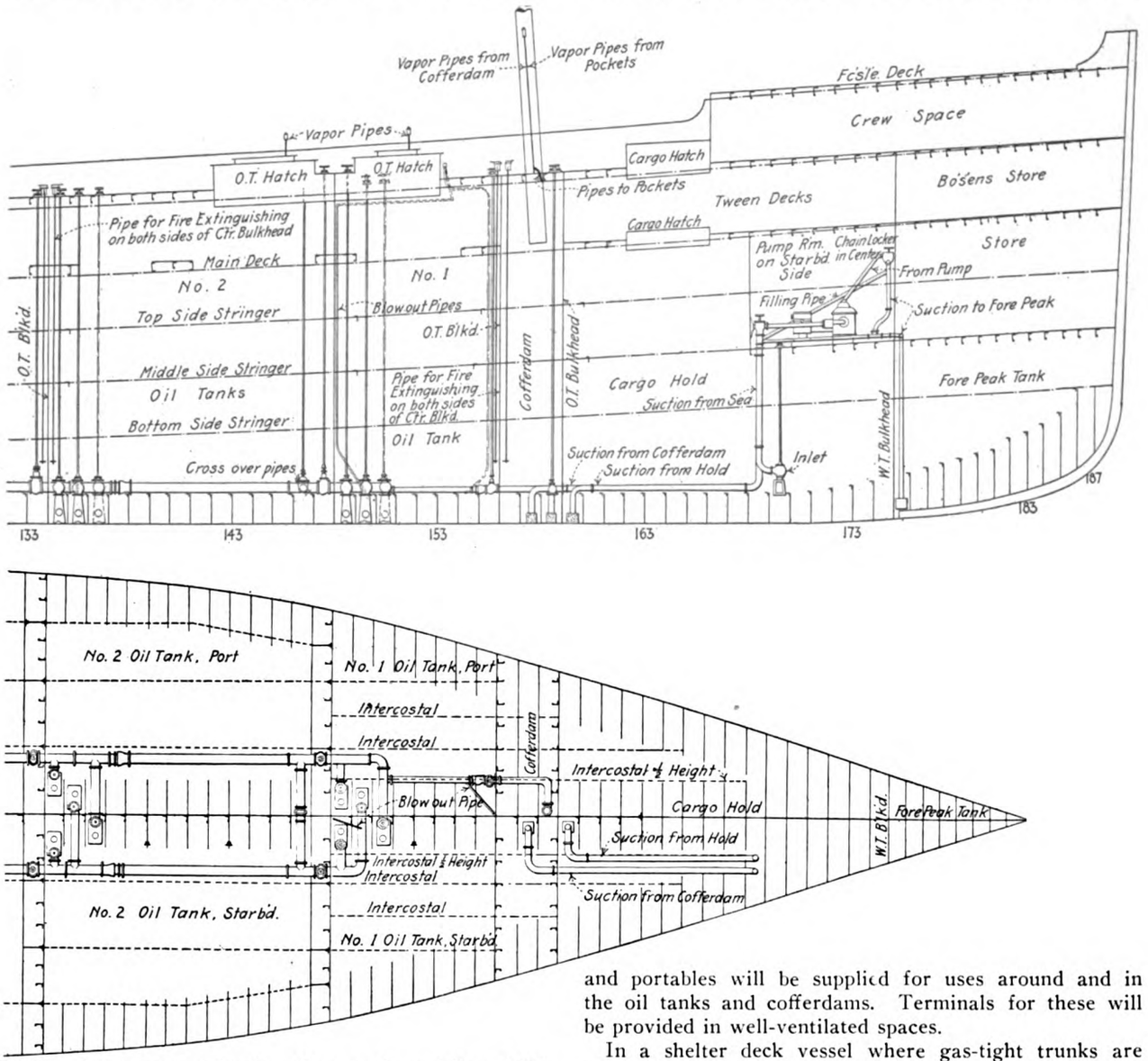

Fig. 19.—Arrangement of Auxiliary Pump in Forward Part of Ship

Electric Lights

If a dynamo is not already installed in the vessel, one of ample capacity should be installed. Only continuous current machines are permitted in oil boats. The old system will have to be rearranged and new additions added. Since these additions will test the total capacity of the machine, a duplicate generator should be installed.

All wire should be carried in conduits to the weather and distributed from there along the deck in watertight conduits. No fuses or switches should be fitted below the deck except in the accommodation spaces. No parts liable to spark are to be fitted in the pump rooms or in any other spaces where fumes are apt to collect. Clusters and portables will be supplied for uses around and in the oil tanks and cofferdams. Terminals for these will be provided in well-ventilated spaces.

In a shelter deck vessel where gas-tight trunks are fitted in the shelter 'tween decks, permanent lights will have to be installed in the spaces outside of these trunks.

Permanent lights in the pump rooms and tunnel will be enclosed in glass globes and wired guards.

Testing

Each tank, pump room and cofferdam will be tested by a head of water as prescribed by Lloyds.

It will be advisable to fill the tanks with water ballast and run the vessel at sea for at least six hours. In this way the tunnel and cofferdam bulkheads would be tested under actual sea conditions.

Only such spaces as used for oil fuel need be calibrated. This is done by filling the tanks from tanks of known capacity. Curves will be plotted showing the capacity of the tank at any given sounding, and in this way accurate figures for fuel consumption are obtained.

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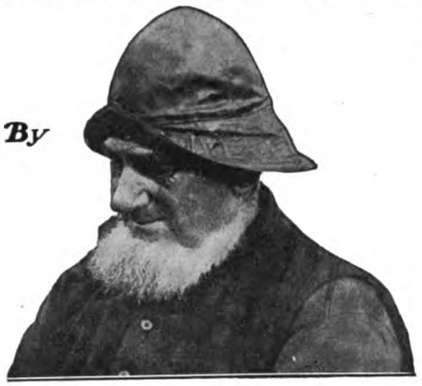
Economy Talks By "Old Scotch"



"Watch Your Pistons!"

In our last number I paid my respects to our old friend "brass," but the joke is on me, I'll have to admit. Shortly after I wrote it I went out on the trial trip of a new vessel, and the lack of a little brass nearly got us into serious trouble. The throttle valve was made of cast steel, and the valve stem, of course, was of wrought steel. At the end of the full speed trial it became necessary to slow down by shutting off the throttle. Try our best, we couldn't turn the 24-inch hand wheel, not even with the additional leverage of a big monkey wrench on the rim of the hand wheel worked by two husky men. Nothing doing —no open, no shut!

Of course we had to work into the dock by putting a man in the upper fireroom, who opened and closed the main stop valve in order to answer the bells from the bridge. When the engine was cooled down another attempt failed to turn the "durned" thing. Still nothing doing. We finally had to take off the throttle valve cover and take the valve disk, stem and cover up to the machine shop. Even with the facilities there that blooming stem wouldn't turn one way or the other. As a last resort we cut off the 1¾-inch stem close up to the stuffing box and then drilled it out. What had happened, you will naturally ask?

The answer is simple. The stuffing box was cast of steel with the cover, and the guide was bored out almost to a fit. Some hard scale from the inside of the casting had worked in between the stuffing box guide and the valve stem, with the result that the wrought steel stem working on the cast steel guide with a few flinty chips or scale for a lubricant had galled. It was easily remedied, of course, by boring out the steel guide and fitting a small neck bushing of brass, so that now we have a new wrought steel valve stem working on the brass bushing, and a child can turn the hand wheel—all of which shows that some brass is mighty good in some places about an engine.

Of course the man who designed the valve knew that steel does not work well on steel, but it was one of those thousands of little details about marine machinery which, unfortunately, he had overlooked.

An old Scotch shipmate of mine used to say:

"Iron on iron works vera fine,
But steel on steel works nae so weel,"

and that brings up a branch of marine economy that I have somehow overlooked, and that is the keeping of pistons tight. Of course steam cylinders always have been and always will be made of cast iron. Pistons nowadays are made generally of cast steel, and, as everyone knows, that material does not work very well on cast iron, so we have to use cast iron packing rings to keep the pistons tight.

But even so, do they keep them tight? I'll venture to say that about half of all steam pistons leak to a greater or less extent, and there's where many a dollar is wasted.

A besetting fault of nearly all marine engineers is that they do not test their engines often enough to detect leakage of this kind. Putting on the indicator and taking a few cards is too much trouble, they say. Of course that will detect large leakages, but a much quicker way is to put the piston on the top of the stroke, turn steam on and then open the bottom indicator cock or cylinder drain. If there is any leakage of steam by the piston it is bound to show up in this test, and, believe me, it will show up in a great many instances. Some engineers will argue that it does not make much difference, anyhow, as what leaks through the high-pressure piston will do some work in the intermediate, and so on. But suppose your low-pressure piston leaks; or suppose, as is often the case, all your pistons leak? In the auxiliaries the leaks are sometimes pretty bad, but they do not amount to so much, on account of the smaller quantity of steam that is used in them.

Now I do not propose to say that I know of any particular kind of piston packing that will keep them absolutely tight. There are probably a dozen different patented devices for packing pistons, some of them very efficient, some of them not very good. In any event it pays to watch them, and as soon as they begin to leak put in new ones. I know one tugboat that has a 10-inch high-pressure cylinder where an ordinary snap ring was used for packing purposes. It simply would not keep the steam from blowing through, so as a last resort the chief engineer tried the experiment of using a solid cast iron piston and cutting four water grooves in the rim for water packing, the cylinder condensation providing the water. This kind of a piston keeps almost absolutely tight for a period of two years. At the end of that time the old piston is thrown in the scrap heap and a new piston of the same kind is fitted. The cost of the new piston is only $18 (3/15/0) and you can bet that it pays for itself in a short time right at the coal pile. For larger cylinders there does not seem to be anything much better than the old-style packing rings set out by little springs. The trouble with these is that the rings will wear down and the springs will lose their elasticity. It therefore pays at intervals to peen out the rings and to have the springs reset and retempered. If you do not believe there is economy in keeping pistons tight, just test some of your own; if they blow through, stop the leakage as much as you can and then watch your coal pile.

When you ride around in the subway these days some one is always shouting "Watch your step!" When you get aboard your ship some one ought to shout "Watch your pistons!"

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Effect of Slipping of Eccentric

Q.—Why does an engine speed up when the eccentric slips? E. E.

A.—If an eccentric slips when an engine is running, it decreases the angular advance. Decreasing the angular advance delays the valve events, and until the slipping is large the predominating effect is that of delayed cut-off with consequent increased revolutions.

Calorific Values of Coal and Oil

Q.—What are fair calorific values of American coal and oil? P. A.

A.—Values customarily taken for general comparisons are 14,000 B. T. U. per pound for coal and 19,000 B. T. U. per pound for oil, but individual grades of each vary largely. Coal from different parts of the United States varies from 10,200 to 15,950 (tests of United States Geological Survey, 1904-1906). American oils run about as follows (from *Marine Steam*, published by the Babcock & Wilcox Company, New York):

Mexican	17,500
Californian	18,700
Texan	19,000

Size, Speed and Fuel Consumption of 600-Horsepower Diesel Engine

Q.—Can you give me approximate overall dimensions and weight of a Diesel engine to produce 600 brake horsepower? Also at what revolutions per minute would it run and what should be expected for its fuel consumption? H. D. S.

A.—A two-cycle marine Diesel engine put out by the Maschinenfabrik Augsburg-Nurnberg (M. A. N.) Company, and listed as one of their "light" type has the following dimensions:

Length overall	15 feet 9 inches
Width overall	3 feet 11½ inches
Height necessary for dismantling	6 feet 11 inches
Depth necessary below shaft	1 foot 8 inches
Revolutions per minute	450
Brake horsepower	600
Fuel consumption, approximately,	0.5 pound per brake horsepower
Total amount, approximately,	21,000 pounds per horsepower

This type of engine is used largely for submarines, gunboats, etc. A similar engine of their "heavy" type, as used in tugs, etc., weighs about 120 pounds per brake horsepower, as against 35 pounds per brake horsepower for the engine described above. The heavy type has a slightly better fuel consumption.

* Associate Professor of Naval Architecture, Massachusetts Institute of Technology, Boston, Mass.

Book on Diesel Engines

Q.—Can you give me the name of a good book on Diesel engines? STUDENT.

A.—"Diesel Engines for Land and Marine Work," by A. P. Chalkley, published by A. P. Constable & Co., London, and in this country by D. Van Nostrand, 25 Park Place, New York.

The Otto Cycle

Q.—What is the Otto cycle? Is it any different from the ordinary four-stroke cycle of a Diesel engine? MOTOR.

A.—The Otto cycle is the four-stroke cycle (1) admission of charge, (2) compression, (3) explosion and expansion, (4) exhaust of burned charge. The Diesel cycle, however, differs slightly from it in that the early part of the third stroke is the injection and combustion of the fuel, and the rest of this stroke is the normal expansion of the oxidized charge. The expansion or third stroke line of the two cycle engine might be compared to the expansion lines of two indicator diagrams from steam engines; one with an extremely short cut-off corresponding to the Otto cycle, and the other with a longer cut-off corresponding to the Diesel engine cycle.

Temperature of Stack Gases

Q.—(1) With six single-ended Scotch marine boilers, 190 pounds steam pressure, oil for fuel, would you consider 600 degrees F. temperature of stack gases good practice? (2) Would it be more economical to bring temperature of stack gases down, say to 400 degrees F. or 500 degrees F., by retarding in the tubes more? (3) Would there be any danger of dropping a furnace crown in consequence? (4) What would be the safe, lowest temperature of stack gases you would recommend, not to take draft into consideration, or assuming that the draft is good?" K. T.

A.—(1) Yes, 600 degrees F. is very good stack temperature for natural draft.

(2) Provided the chemical composition of the flue gases is not changed disadvantageously, any reduction in stack temperature which may be made is a gain, as less heat is thrown into the air. It might be possible to bring the stack temperature to 500 degrees, but I think it doubtful if a temperature as low as 400 degrees could be obtained in this installation without attendant undesirable features.

(3) Probably not, but this question cannot be definitely answered without a study of the drawings of the boiler and uptake.

(4) 450 to 500 degrees F. There is a theoretical discussion based upon the difference in density between the heated air and the cold air which leads to the general conclusion that the best natural draft occurs in chimneys when the *absolute* temperature of the hot gases is $\frac{25}{12}$ of the surrounding atmosphere. This takes no account of the increase of draft due to the aspirating effect of the chimney top and other important effects, but is interesting and gives us some information. To take a specific case,

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if the air were at 60 degrees F. the absolute temperature corresponding would be equal to 60 degrees + 460 degrees = 520 degrees absolute.

$$520 \times \frac{25}{12} = 1{,}085 \text{ degrees absolute} = 625 \text{ degrees F.}$$

Experience from actual trials seems to indicate that for natural draft, stack temperatures of from 600 degrees to 700 degrees F. are acceptable and temperatures 450 degrees to 550 degrees F. for forced draft and small tube conditions. Higher temperatures are frequently found when the grates are forced to high rates of combustion or large capacity oil burners are used.

Equivalent Evaporation

Q.—Will you please explain what is meant by "equivalent evaporation"? B. M.

A.—If there are two exactly similar boilers, one operating at 250 pounds pressure and the other at 70 pounds pressure and burning the same fuel, the boiler with 250 pounds pressure will evaporate less water per pound of coal than the 70-pound boiler, simply because more heat is required to vaporize a pound of water at 250 pounds pressure than at 70 pounds. Obviously, it would be unfair to quote boiler performances in terms of evaporation which did not take account of the pressure and quality of the steam delivered. This led to the custom of reducing all test evaporations to a common standard known as "equivalent evaporation from and at 212 degrees," which is the amount of water which would be evaporated at atmospheric pressure from feed water at 212 degrees by the B. T. U. used to evaporate one pound under the actual conditions.

For example, the boiler operating at 70 pounds pressure generates steam with a total heat of $r + q^* = 286.2 + 896.8 = 1{,}183$ B. T. U. If we consider the feed temperature was 100 degrees F., then the feed water had a heat contents of $q = 68$, so that the net B. T. U. put into each pound of water to vaporize it into steam was $1{,}183 - 68 = 1{,}115$ B. T. U. In a similar way for steam to be formed at atmospheric pressure from feed water at 212 degrees requires 969.7 B. T. U. ($r = 212$ degrees), therefore

$$\frac{1{,}115.0}{969.7} = 1.150$$

is the factor by which the actual evaporation of the boiler at 70 pounds pressure should be multiplied to reduce it to the "equivalent evaporation from and at 212 degrees." For the 250 pounds boiler using feed at the same temperature (100 degrees) this factor is 1.169. (For table of these factors for a wide range of pressures and feed temperatures, see Kent's Handbook, page 875 *et seq.*)

Air Vessel on Pump Suction Line—Number of Coils in Safety Valve Spring

Q.—What are the advantages of having an air vessel on the suction pipe line of a pump the same as on the delivery? And what would be the best position in which to place such an air vessel? We have a pump which does "general service" and has already broken its suction pipe away from one of the flanges, owing, probably, to the excessive jarring and vibration which take place when we are pumping on the ash ejector.

Please give a simple illustration showing how to determine the number of effective coils in a safety valve spring.

A.—In pumps which have long suction lines it is quite as essential to fit an air vessel on the suction line as on the delivery, but great care should be taken to properly locate it. It should be placed near the pump and so that it forms a continuation of the straight length of suction line. The action of the pump causes rapid changes in the velocity and there is apt to result a serious water hammer unless this precaution is taken. Your reason for the breaking of the suction pipe at the flanges is probably correct.

There are several forms of spring formulæ, depending upon what items are considered as known. For the instance given there would probably be known the dimensions of the spring wire, load and material, and for that case the following formula would probably be used as the movement of the loaded point is usually one of the major elements of the design. The formulæ for this case follow:

$$\delta = \frac{12 R^3 X L}{b h (b^2 + h^2) C}$$ for springs made of wire of rectangular cross section

and

$$\delta = \frac{32 R^3 X L}{\pi d^4 C}$$ for springs made of wire of circular cross section

The letters have the following significance:

δ = displacement of point (in inches) when load is applied,
L = load in pounds,
R = radius of spring,
X = total length of wire forming spring (not length of spring),
b and h = sides of rectangular spring wire in inches,
d = diameter of round spring wire in inches,
C = shearing modolus of elasticity.

Example—Suppose we wish to know how many turns of ¼-inch diameter round steel wire will be necessary, if rolled into a spring of 2-inch diameter to support a load of 10,000 pounds on a deflection of 2 inches. For steel of this sort, $C = 12{,}600{,}000$; therefore

$$\delta = \frac{32 R^3 X L}{\pi d^4 C},$$

so

$$2 = \frac{32 \times 1 \times X \times 10{,}000}{\pi \times \frac{71}{256} \times 12{,}600{,}000}$$

and

$$X = 68.6 \text{ inches.}$$

Each coil is 2π inches long, so the number of coils is

$$\frac{68.6}{2\pi} = 10.9.$$

CORRECTION.—In the answer to the question regarding the stresses in expansion bends of steam lines, published on page 314 of our July issue, it is stated that the straight pipe will increase in length $48 \times 12 \times .0000065 \times 310 = 1.61$ inches. There is a typographical inversion of figures in the result given. Instead of 1.61, it should be 1.16, which is the figure used a few lines below in the answer.

SHIPBUILDING IN CANADA.—The Department of Marine and Fisheries of Canada, in its report on shipbuilding in Canada during 1914, gives a total new tonnage of 43,346, the largest figure in fourteen years. Over half of this tonnage was built in the province of Ontario.

MEMBERS OF INVENTIONS BOARD.—The names of four members of the proposed advisory board on naval inventions for the United States Navy have been announced. Those selected by the American Society of Mechanical Engineers are Spencer Miller, of New York, and W. L. R. Emmet, of Schenectady, N. Y. The Society of Automobile Engineers has chosen Howard E. Coffin and Andrew L. Riker, past presidents of the society.

* r = heat of vaporization
q = heat of liquid
Steam Properties from Peabody's Tables at Pres. = 70 + 14.7 = 84.7.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Design of Spare Propellers

A British steamship was towed into Bermuda a few weeks ago with her tail shaft broken and the propeller gone. The vessel was towed a distance of about 1,100 miles, which meant not only a loss of time to both towing and towed vessels, but a heavy bill for towage to be taken care of by the underwriters. The accident happened in moderate weather, and conditions were favorable for "tripping" the vessel at sea and for withdrawing the broken shaft and replacing it with a spare shaft and propeller, but as assistance was offered a few hours after the breakdown it was considered advisable to accept it.

The spare propeller which was carried on deck was a regulation four-bladed solid cast iron one, 18 feet in diameter and of considerable weight. It would have been necessary to have removed the propeller from its location directly aft of the mainmast to a point further aft, a distance of probably 65 feet, and then to have lowered it over side in a convenient location for fitting it on to the tail shaft. The ordinary derrick and gear of tramp steamers is usually not sufficiently strong to handle safely such a large weight, and, aside from the probable loss of the propeller, should the gear give way a serious accident to the crew, and possibly death, might accompany such an accident.

For convenience of handling, easily and safely, under the ever-present difficulties in performing work of this nature at sea, why not adopt a sectional, two-bladed propeller for the spare? This would consist of a boss and two blades, each piece easily handled without special rigging and for all practical purposes just as efficient as the ordinary four-bladed wheel. The diameter and pitch would be similar to that of the four-bladed wheel, and probably 75 percent of the surface could be provided for in the two blades. While this may cause a slightly increased "vibration," yet it would only be for a comparatively short time, as vessels are invariably dry docked at the first convenient port.

W. Blackburn Smith,
Official Marine Surveyor, Bermuda.

Fire-Room Emergency Escape

The sinking of the *Titanic*, with her frightful toll of life, caused nations and peoples to pause and consider what steps could be taken to insure greater safety for those "who go down to the sea in ships." This awakening took the form of national and international safety-at-sea congresses, resolutions by civic bodies, boards of trade and chambers of commerce. It gave rise to articles in the daily press, in shipping and trade journals, to discussions in engineering and technical societies, and to the publication of books describing the "unsinkable *Titanic*."

The greatest good, by far, resulted from the deliberations of official congresses, and from such of their recommendations as have been given the force of law or executive order by the various maritime nations. These recommendations dealt chiefly with stability, watertight integrity, capacity and availability of lifeboats and their proper handling, and were intended to protect the passengers from the fury of the waves.

Scarcely a recommendation, suggestion or admiralty order took into account the safety of those hard-working members of the crew who are imprisoned below in the firerooms and engine rooms, and who, being out of sight are out of mind, but without whom the five-day passage of the Atlantic is impossible. It seems to have been forgotten that these men with their officers are daily and hourly exposed to the danger of escaping steam from a ruptured pipe or damaged boiler. Neither did the discussions or safety orders take into account the fact that as safety for passengers is secured by greater subdivision and unpierced bulkheads the chances of firemen avoiding injury from escaping steam is correspondingly reduced.

In the United States navy only, so far as is known to the writer, were any steps taken to provide firemen with better chances for escape in case of boiler damage or steam-pipe rupture. On the *New York* and *Texas*, the two latest dreadnoughts commissioned, the naval constructor provided inclined vertical trunks leading direct from the fireroom floor plates to the gun deck level. There is one of these trunks on each side of each fireroom, each communicating with the fireroom by means of a full-size ship standard door above the floor plate level. This trunk and its door is shown in "A" in the illustration.

These trunks were considered necessary on ships that have communicating doors through bulkheads separating adjacent machinery compartments. Naturally these doors afford means for men to escape from one compartment to another without the necessity of climbing up in the path of the steam flow. How much more necessary will be real emergency escapes in the case of vessels where the bulkheads are unpierced, or are only pierced for standard manholes!

This construction, if not already an accomplished fact, is likely to be brought about as a result of such investigations as followed the *Titanic* disaster, and from the experiences of the great war now waging in Europe. If proof be needed to show the necessity for emergency escapes and to emphasize the inadequacy of the inclined trunk as now fitted in certain men-of-war, the accident on the U. S. S. *Salem* at Progresso, Mexico, last fall furnishes it.

The *Salem*, a scout cruiser, is equipped with Fore River boilers and engined with Curtis turbines. Her boilers are arranged four in each of three watertight firerooms. There is no communicating door between firerooms. The bunkers are outboard of and adjacent to the firerooms, one bunker abreast each boiler, approximately. The bulkhead between the fireroom and bunkers is pierced for a standard watertight door. There is no means of escape from the fireroom except through the roof of the fireroom or into adjacent bunkers, or possibly into double bottoms under the fireroom bilge, if there should be time.

While backing at full speed coming to anchor at Progresso, Mexico, the steam and water was hauled out of No. 1 boiler so rapidly that the inexperienced crew permitted, or rather failed, to prevent low water, which resulted in pulling some four or five tubes out of the tube sheet of the steam drum. The inswinging furnace doors held, but the ashpan doors gave way, so that fire, ashes and steam blew out near the floor plate level, filling fire-

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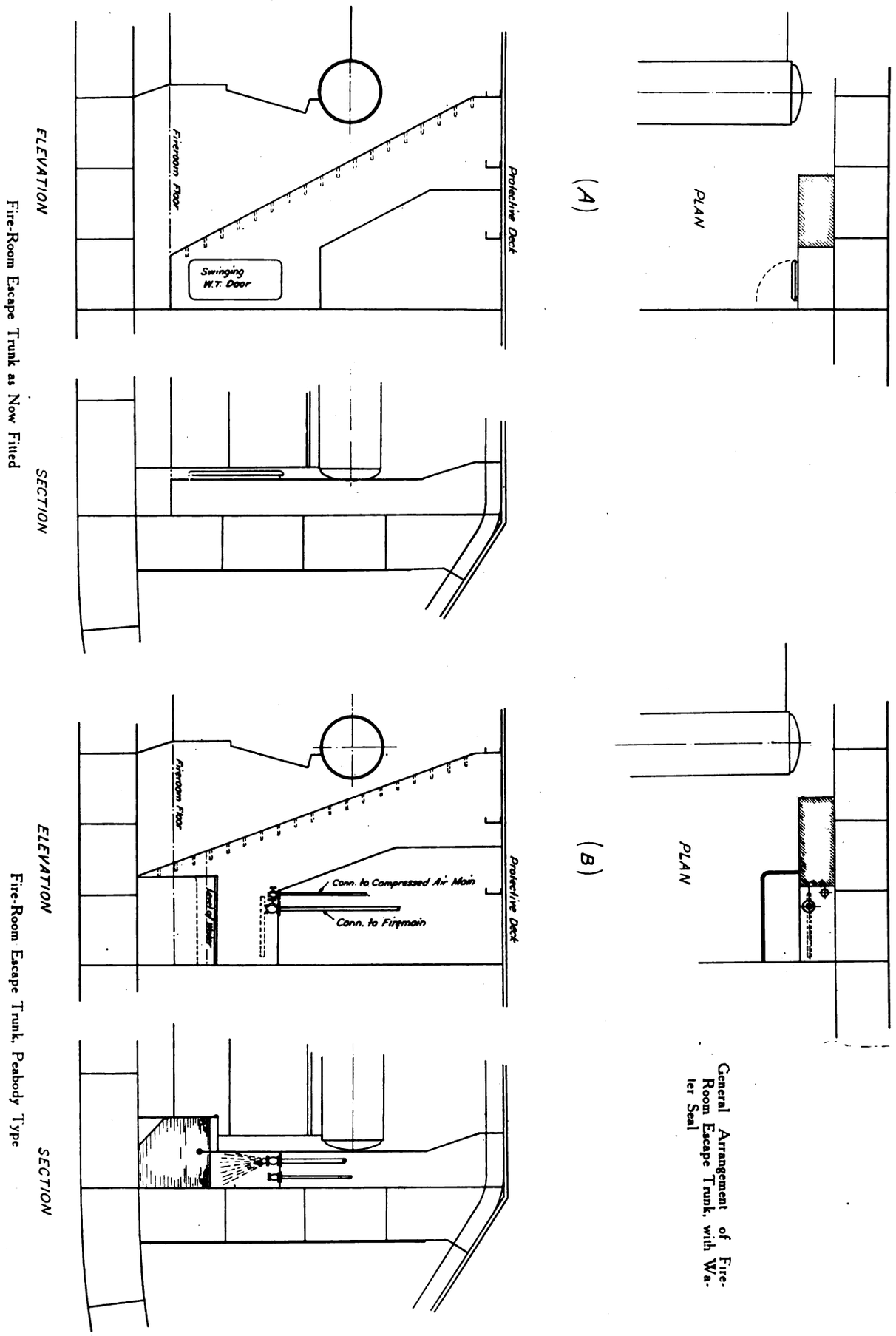

Fire-Room Escape Trunk as Now Fitted

Fire-Room Escape Trunk, Peabody Type

General Arrangement of Fire-Room Escape Trunk, with Water Seal

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room with steam and noxious gases. Some of the men in attempting to escape up through the fireroom sprung the cover of the escape hatch in the roof of the fireroom, relieving the air pressure in the fireroom, thereby increasing the escape of steam into the fireroom.

Before the men who were in the open fireroom could get over the port side and pass into coal bunkers on the uninjured side of the vessel, two men were fatally burned. One coal passer was in the bunker abreast No. 1 boiler, the bunker door being open. Notwithstanding the fact that the bunker was otherwise closed, so that no chimney effect was produced, still the steam rushed into this open bunker space in such volume and with such velocity that the man was scalded to death in the forward end of the bunker where he was shoveling coal.

The fact that steam flowed promptly into the empty space of this bunker through a door of the same size and located at the same level as the door to the escape trunks on the *New York* and *Texas* shows conclusively that with the draft induced by the chimney effect of the vertical inclined trunk it would invite disaster in a real emergency. Men would enter it in the frantic endeavor to escape, but the steam, at a considerable velocity, would scald men well up the ladder so that they would tumble on those below and a veritable death trap would result.

The two men who were in the open fireroom undoubtedly could have escaped fatal burns if they might have dropped into a tank of water on their own side of the fireroom and moved through the water (an effectual steam seal) to the far and safe side of the bulkhead separating the fireroom from the escape trunk.

An emergency escape for permitting men in a compartment to reach a point of safety, while at the same time preventing steam or other gases from following, has been developed largely through the efforts of Mr. Ernest H. Peabody, chief engineer of the Babcock & Wilcox Company. This device, as applied to the present escapes on the battleships *New York* and *Texas*, will be readily understood from the illustrations.

In view of Secretary Daniels' well-known interest in the welfare of the enlisted men, and of his recent determination to create an Advisory Board of Invention under the Navy Department, INTERNATIONAL MARINE ENGINEERING presents this invention on its merits, believing it will offer greater safety to the crews of both naval and other vessels than has heretofore been provided, feeling assured that the Navy Department will lead in the "Safety First" crusade.

Explosives of the Engineer's Department

Would you be willing to sit on a high explosive shell or on a submarine mine and peacefully smoke your pipe, or would you allow one of your men to do it? I think you would hardly do either, yet, dangerous as this seems, there would not be very much danger to the smoker, because in both cases the explosive is well protected and must be detonated by special means. A little flame or a few sparks around it would be quite harmless.

But while the very suggestion of the use of a high explosive shell for a smoking seat seems preposterous and sounds like an attempt to commit suicide, many of you are doing and allowing others to do much more dangerous things around your steam pipes and boilers. By this I mean that you are working around live steam, under high-pressure, under conditions that would make a packer of high explosives quit the job, because he would find it too dangerous for him.

The presence of steam, at pressures from 125 to 265 pounds, in steam lines and boilers, in many places separated from the operator by only a thin gasket held between two flanged and bolted surfaces, ought to contain a sufficient element of danger to satisfy even the most foolhardy. That it does not is conclusively shown by the overpowering desire that so many men (and even some engineers) seem to have to work at every joint that shows signs of leakage or failure. If this desire to work were expressed when the steam was turned off the line, it would be quite commendable, but, working as they do with full pressure on shows that the operators are either foolhardy or ignorant of the great danger to which they are subjected.

The most usual place for leakage to occur on board ship is at a flanged joint. In practically all such cases the flanges are secured together by ordinary commercial bolts. Any person can easily understand that flange bolts must be under a considerable stress when well set up, especially when pressure is on the line. The metal of these bolts may be of poor quality; very few of us are in a position to know just how good the metal of any particular lot of bolts was when installed. Many bolts may have been cracked and have rusted badly in these cracks. Some may have the threads practically stripped, while in others the whole bolt may be badly rusted. In nine cases out of ten the workman does not know the condition of the bolt when he puts his wrench on it.

If the bolt carries away or the threads strip, what is going to happen? Usually not very much, I am glad to say; but there are grave possibilities, as has been repeatedly demonstrated by many serious burns and scalds received by men at this work. If there are more than three bolts in the flange, the only damage will probably be a piece of the gasket blown out at the point where the broken bolt occurs, but if there are three or less, the flange may open quite badly, releasing a jet of steam and scalding water. Since the operator will probably be on the side on which he is making repairs, he stands a very good chance of getting badly burned, especially about the hands and face.

The possibilities (and probabilities) of accident are not limited to the case of a flanged joint as just described; instead of this, they extend to all parts of steam machinery. The danger from small galvanized iron pipes with screwed unions and couplings is very real. It is not an uncommon thing for such a pipe to break completely off in the threads when a particularly strenuous effort is made to set up on it.

Of course the greatest of all such dangers lies in the attempts frequently made to set up on a manhole plate when the boiler is steaming. Except in case of emergency this is absolutely inexcusable, as the accidental breaking of a dog, nut or stud may cause the death of everyone in the fireroom. In every such case the pressure should be taken off the boiler before attempting repairs.

The writer realizes that it is necessary to carefully follow up newly made joints as the pressure comes on them, but not after the pressure is fully on. It is only when working with such a joint as that made on a cylinder head, where there are a great many holding bolts, that setting up can be done with impunity.

Some object to allowing the pressure to be removed from a boiler before working on it on the plea that it takes too much time and is too expensive. It cannot be denied that it does take time, is expensive, and may be the cause of great inconvenience, but nevertheless it is worth while in the end.

The writer has found that, when working with boilers, it pays to warm up the boiler and follow up the newly made joints as soon as the job is finished, rather than to

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wait until the boiler is needed and then find several gaskets leaking. Warming up is done in a Scotch boiler by using the hydrokineters and circulating the water with a spare feed pump. The temperature will soon reach the boiling point and some steam pressure can be obtained in this manner. If the gaskets are all well followed up and all prove to be tight, there is very little chance that they will give trouble when fires are lighted for service. It is surprising to see what a little difference in the coal consumption will be made by carrying out this process on one boiler. The difference is hardly noticeable.

The same process is carried out in a watertube boiler by using a very light fire. The whole operation can be done in two or three hours, and if it is necessary that the boiler shall be ready for service without fail at a set time, it will be found to pay in the long run.

The writer would not say that steam joints should never be set up while under steam, but he desires to say that it should only be done in case of some reasonable necessity, and even then in a very circumspect manner and with the greatest of caution. W. W. B.

Some of the Most Common Troubles with the Marine Gas Engine and Suggestions for Determining and Remedying the Same

While it is almost impossible for one to enumerate all of the conditions which will interfere with the efficiency of a marine gasoline (petrol) engine, it is the writer's purpose in this discussion to consider the most common causes of trouble and give practical suggestions for determining and remedying same. To the expert much of the matter presented may seem superfluous and elementary, yet it is believed that it will be of interest and benefit to the average reader who is interested in the gas engine for marine propulsion.

The first point to be considered is the amount of compression obtainable in the engine cylinder, for upon this depends the successful and economical operation of the engine. Different fuels require different compression pressures, the average compression of an engine using gasoline (petrol) being between 65 and 70 pounds per square inch, while for an engine using kerosene (paraffin) should be in the neighborhood of 50 pounds. The amount of compression may be determined by inserting a pressure gage in the spark plug or priming cup opening and turning the engine over briskly by hand.

In cases where the compression is found to be too little and it is positively known that no compression leaks exist, the following methods are available for increasing same:

(a) Adding liners between the connecting rod brasses.

(b) Fitting a longer connecting rod.

(c) Lowering the position of the piston pin in the piston.

(d) Fastening plates to the top of the piston or under side of the cylinder head.

(e) Decreasing the gasket between the cylinder and cylinder head, or between the upper crank case and bed plate.

It is upon the fit of the piston and rings, more especially the latter, that compression mainly depends. The piston should fit the cylinder bore with but little looseness, the general practice being to allow about .005 inch clearance at the top and about .003 inch at the bottom. The piston rings should possess sufficient elasticity or springiness to press uniformly against the cylinder walls, and should be so located in the piston that no two joints come in line with each other. The rings should slide freely in their grooves, but should have no perceptible side movement.

The importance of having the compression exactly right should not be overlooked, and it is therefore essential that the engine be tested frequently for leaks. This test may be made by turning the engine over against compression and holding it at that point where compression is at its maximum. Should there be any leakage, the effort necessary to hold the engine in this position will gradually decrease. For multiple cylinder engines this procedure should be followed on each individual cylinder, the compression being relieved on all cylinders except the one under test.

While the engine is running, compression leakage at any accessible part, such as the cylinder head joint, spark plug, etc., may be determined by squirting a little lubricating oil around the place where the examination for leakage is to be made, and if a leak exists bubbles will appear in the oil.

A dark discoloration along the outer circumference of both piston and rings is a positive sign that the hot gases of combustion have been leaking by them and steps should be taken immediately to locate and remedy the trouble.

Often it will be found that the rings are stuck, due to a gummy deposit in the grooves caused by excessive lubrication or a poor grade of lubricating oil. If such is found to be the case, they should be first loosened by soaking in kerosene (paraffin), carefully removed and the grooves thoroughly cleaned of all deposit. To remove a piston ring, three pieces of tin or sheet brass about ⅜ or ½ inch wide by 6 inches long should be provided. By slipping one piece under each end of the ring and one under the middle, the ring can easily be removed.

Examine the rings to see whether they possess sufficient elasticity to function properly. A weak ring may sometimes be improved by lightly peening it on its inner surface, the outer surface resting on a hard, smooth foundation. This operation, which tends to expand the ring and cause it to press harder against the cylinder walls, must be carefully performed, due to the fact that the rings are generally made of cast iron, which is very easily broken. If the piston rings work around in their grooves so that their joints come in line, compression leakage is very liable to result. To avoid this trouble, fasten the rings in their proper location by means of small pins, taking care that these pins are securely held in the piston and are of ample size, so as not to shear off.

Shiny spots at the joint and diametrically opposite indicate that the ring does not fit the cylinder bore properly. In manufacturing piston rings they are made slightly larger than the cylinder bore and then split in order that they may enter the cylinder. After being split the ring should be pressed together and the outer surface turned or ground to a true circle, otherwise they will assume an elliptical form when placed in the cylinder and not fit the bore properly. Perfect fitting rings should show bright all around the outer circumference.

A piston that is worn will permit the charge to leak past and thereby cause a loss of power. When worn to a considerable degree, the piston will make a slapping noise against the cylinder bore. In this case the only remedy is to fit a new piston. In replacing a piston in a cylinder having its head cast integral, care must be taken not to slide it in too far, as there is danger of the top ring sliding past the counter-bore, or the enlarged diameter of the combustion chamber. If this happens, the ring will instantly expand over the edge and prevent the piston from being returned to its proper position.

Should compression leakage be traced to the piston, the

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trouble, if caused by the rings being stuck, can often be overcome by pouring about half a cup of kerosene (paraffin) into the cylinder through the spark plug opening or priming cup and allowing it to stand for several hours. The kerosene (paraffin) cuts and dissolves the gummy deposits and allows the rings to move freely. After the rings have been freed in this manner, rinse out the cylinder with more kerosene (paraffin) and well lubricate it before again starting the engine.

A cylinder that is scored or scratched, or one that is worn out of round, is often the cause of lost power and overheating. A scored cylinder may be the result of overheating, broken piston rings or a loose piston pin. In cases where the scoring is only slight, a small quantity of graphite mixed with the lubricating oil and fed to the cylinder will fill in the scratches and make the cylinder bore perfectly smooth. If this procedure should not prove satisfactory, regrind the cylinder and fit new rings in the piston. When the cylinder is found to be worn out of round or to be deeply scored, the only remedy is to rebore it and fit a new piston of larger diameter.

Compression leakage can often be traced to the joint between the cylinder and cylinder head, and if this trouble cannot be remedied by tightening up the studs that hold the head in place a new gasket must be provided. This gasket should be about 1/32 inch thick and of a material that will withstand a high degree of heat as well as pressure.

In removing a cylinder head for the purpose of fitting a new gasket, do not hammer it or insert a chisel between it and the cylinder. After removing all the connections and the nuts that fasten the head in place, turn the engine over against compression and the pressure will loosen the head and make its removal easy. Carefully scrape the bearing surfaces of both cylinder and head of all traces of the old gasket. Cut the new gasket, taking care that it does not project into the cylinder and that there is sufficient clearance around the stud holes to prevent it from buckling and thereby preventing the head from seating evenly. Coat the surface of the gasket that comes in contact with the cylinder head with a mixture of tallow and flake graphite. This will prevent the gasket from sticking to the head and permit of its removal without destroying the gasket. When the head is in place, first tighten up all the nuts with the fingers; then, using a wrench, tighten up each nut a trifle at a time, going around the cylinder three or four times and exerting the same pull for each nut until they are all as tight as it is possible to get them. Never apply full pressure to one nut before the others have been tightened, as such a procedure will tilt the head and make a perfect seating impossible. After the engine has started and thoroughly warmed up, go over the nuts again and tighten them up still further.

In the case of the two-cycle engine, loss of power can often be attributed to a leaky crank case, due to defective gaskets or worn crankshaft bearings. Remedy this trouble without delay, for it must be borne in mind that no two-cycle engine can operate efficiently unless the crank case is absolutely tight. The amount of crank case compression should be in the neighborhood of six pounds per square inch.

The valves and their operating mechanism are a prolific cause of compression leakage, and particular attention should therefore be paid to these parts. For efficient operation the valves and valve seats should be perfectly smooth and free from grooves or pitting. Often a particle of carbon or grit will lodge between the valve and its seat and prevent the valve from seating properly. This can usually be dislodged by rotating the valve on its seat. The intense heat in the cylinder and the action of the gases on the valves not only causes them to warp, but also causes the seating surfaces to become rough and pitted, thereby causing compression leakage and loss of power. The most trouble in this respect is due to the exhaust valves, which are surrounded by hot gases during the exhaust stroke.

Leaky inlet valves are usually indicated by back-firing or explosions in the carburetor and intake manifold, due to the flame leaking through the valve and igniting the fresh mixture in the intake. Leaky exhaust valves will cause misfiring or loud explosions at the exhaust outlet, due to part of the combustible mixture escaping through the valve into the exhaust pipe and being ignited by the succeeding exhaust of the engine.

Valves which are found to be worn or pitted should be ground without delay, otherwise the trouble will soon increase to such an extent that the only remedy will be the fitting of new valves. To regrind a valve, first lift it from its seat and apply a mixture of lubricating oil and fine emery, or any good valve-grinding compound, to the seating surfaces. Now replace the valve and, applying just enough pressure to insure contact between the two seating surfaces, rotate the valve back and forth, lifting it from its seat occasionally to prevent grooving and to redistribute the abrasive. When both valve and seat present a smooth, even surface the grinding is complete, but for accuracy the following test should be made: Spread a little Prussian blue over the valve seat, return the valve and, applying a slight pressure, give it a fraction of a turn. If the surfaces have been perfectly ground the blue will show uniformly spread over the seat, otherwise bare places denoting high spots will be seen. When grinding valves in place on an engine, take care to prevent any of the grinding compound from gaining access to the cylinder bore by stuffing up all openings with waste. After grinding, wash the valves, valve stems and guides with kerosene (paraffin) in order to remove all traces of the grinding compound, which, if permitted to remain, would cause wear and cutting.

Weak or broken valve springs will prevent the valves from seating properly. Weak springs, which have lost their temper due to excessive heat, may be detected when the engine is running by inserting the end of a screw driver in the spring and pressing it against the collar on the valve stem. This increases the tension of the spring, and if the engine now operates better it is a sign that the spring is too weak to function properly and should therefore be replaced.

When the valves are closed there should be a clearance between the valve stems and their operating mechanisms, for if these parts were continually in contact the valves would not be able to seat properly and leakage would be the result. The amount of clearance depends on the size of the engine and varies from the thickness of a visiting card for small engines to about 1/8 inch for large engines. Wear on the valve seats and regrinding decrease the clearance, and care must therefore be taken to keep it the same as it was when the engine was new.

Excessive cooling of the cylinder walls is another cause of lost power, due to the fact that a great amount of heat which otherwise would be transformed into mechanical energy is absorbed by the cool walls. Regulate the volume of water delivered to the jackets so that the temperature of the discharge will be in the neighborhood of 140 degrees F. Insufficient cooling will cause rapid wear of the cylinder and piston rings, due to the excessive heat destroying the lubricating oil.

Faulty carburetion will greatly reduce the power and efficiency of the best engine built. It is essential that the mixture be exactly correct, neither too rich nor too lean,

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for in either case loss of power and irregular operation will be the result. A mixture that is too rich is indicated by the engine gradually slowing down or misfiring badly with black smoke issuing from the exhaust outlet, while a lean mixture is indicated by the engine back-firing and coming to a sudden stop.

If the above trouble is noted when the engine is running at low speed, see that the air valve is seating lightly but firmly and regulate the amount of fuel by means of the needle valve. If the trouble is noted at high speed and the carburetor has been properly adjusted for low speed, increase or decrease the tension on the air valve spring as the occasion may require—i. e., if the mixture is too rich, decrease the tension, and if too lean, increase the tension. If this does not remedy matters, it will be necessary to regulate the fuel by means of a slight adjustment to the needle valve. Endeavor to make all adjustments for high speed by means of the air valve, for any change in the needle valve will interfere with the low speed adjustment.

There are numerous types of carburetors on the market, but for marine purposes the float feed type is generally used. With this type of carburetor the most probable cause of imperfect carburetion is the failure to maintain the proper level of fuel in the float chamber and consequently at the spray nozzle. If the level is too high, the mixture will be too rich, and if too low, the mixture will be too lean. This trouble may be caused by particles of dirt lodging between the float controlled valve and its seat, thereby preventing the valve from seating properly and allowing too much fuel to enter the float chamber, or it may so constrict the opening as to prevent sufficient fuel from entering. Often it will be found that the float has become heavier by absorbing the liquid fuel, in which case too much fuel will be admitted to the float chamber. If a particle of dirt lodges in the spray nozzle it will prevent the passage of sufficient fuel to insure proper mixture. Air leaks between the carburetor and the engine are to be avoided, as the air will dilute the mixture and cause loss of power.

The ignition system is more susceptible of derangement than any other part of the engine, and is perhaps the greatest source of trouble to the average motor boat owner. Troubles are indicated by the same symptoms as are troubles with the carburetion system, and for this reason it is sometimes very difficult to determine which system is at fault.

When the engine has been operating irregularly or misfiring, look first to the source of energy, if a battery system is employed. Go over the wiring and see that there are no broken leads or loose connections. Examine the timer for defects and make sure that no short-circuits exist. If, in addition to misfiring, the engine occasionally back-fires and it is known that the trouble is not due to faulty carburetion, examine the timer and vibrator adjustment or the magneto contact points. Misfiring will also be caused by spark plugs having broken insulation or too wide spark gaps, the latter cause being particularly noticeable when high tension magnetos are used.

Loss of power will be caused by weak batteries and underspeeded or dirty magnetos, or by running the engine with the spark retarded or advanced too far. If a dry battery is used, test each cell separately and if any are found to be weak or exhausted, replace with new ones. For efficient operation a dry cell should show not less than six amperes. A storage battery that shows loss of capacity should be carefully examined. This may be caused by insufficient or impure electrolyte, sulphated plates, sediment in the bottom of the cells, or short circuits in or between the cells. For testing dry batteries an ammeter is preferable, but for storage batteries a volt-meter must be used.

A spark that is retarded too far will not ignite the mixture until after the piston has completed part of its power stroke; consequently combustion will be slower, due to the decrease in compression, and a great amount of heat that would otherwise be transformed into mechanical energy is lost through the cylinder water jackets. In addition to lost power, a retarded spark will cause overheating and back-firing. A thumping or pounding sound in the cylinder is an indication that the spark is advanced too far.

Dirty spark plugs are the most frequent cause of misfiring, and for this reason they should be frequently examined and cleaned. Plugs with cracked or oil-soaked insulators should be replaced. See that the sparking points are not too widely separated. For batteries the gap should be 1/32 inch, while for high tension magnetos it should be about 1/64 inch.

Improper vibrator adjustment is the cause of much trouble and expense, as it uses up the batteries and wastes fuel. Adjust vibrator by first setting the spring rather stiff and running the engine at full speed until it is thoroughly warmed up. Then slowly and gradually decrease the tension of the spring until the engine begins to misfire, at which time slowly increase the tension until misfiring stops and the correct adjustment will be the result. The vibrator contact points should be kept clean and smooth.

The question of lubrication should be given the utmost consideration, for without efficient lubrication the best of engines work badly and will soon be worn out. The chief aim of all lubrication is to prevent an immediate metallic contact of parts that glide upon each other, and by introducing a film of oil between them, friction is diminished and the heat carried off better.

In regard to the lubrication of the cylinder there are special points to be considered, for it must be remembered that the cylinder walls stand alternately in communication with the piston and the hot gases of combustion. The greatest care, therefore, should be taken in the selection of the cylinder oil, and nothing but mineral oils capable of withstanding the excessive heat should ever be used. Never use machine oil or steam engine cylinder oil, as they are of low fire test and will burn instantly, leaving a deposit in the cylinder.

The lubricating oil must be free from acids and other constituents, such as sulphur, which attack the surfaces and cause damage. If the lubricating oil which drops from the cylinder is of a brown and dirty color, it is a sign that something is amiss. Lubricating oil may be tested for free acid by inserting a piece of litmus paper in the oil. The presence of acid is denoted by the paper turning red. For the lubrication of bearings any good grade of acid free oil can be used.

Excessive lubrication or a poor grade of lubricating oil will result in the formation of carbon deposits in the cylinder and combustion chamber. This carbon is to be found in two forms, one being soft like soot and the other hard like coke. The soft carbon mixes with the gummy residue of the lubricating oil and clogs the piston ring grooves, thereby causing the rings to stick. It also fouls the spark plugs and causes short circuits. Particles of the hard carbon, which usually form at the hottest part of the engine, often become incandescent when the engine is working under a heavy load and, by igniting the incoming charge, cause back-firing. Yellow or blue smoke at the exhaust outlet indicates that too much lubricating oil is being fed to the cylinders.

Norfolk, Va. J. B. SADLER.

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Marine Articles in the Engineering Press

Overcoming the Cracking of Pistons in Diesel Engines—Evolution of the Oil Tank Ship—Large British Collier

Cracked and Seized Pistons on Diesel Engines.—This article consists of a full abstract of the remarks of Mr. George E. Windeler, chief engineer of Messrs. Mirrlees, Bickerton & Day, Ltd., given at a meeting of the Diesel Engine Users' Association, at which the subject of cracked and seized pistons was discussed. These remarks are based entirely on investigations carried out by the firm with which Mr. Windeler is associated. In the internal combustion engine, especially of the Diesel type, everything possible is done to keep down the temperature of the cylinder liner, cylinder cover, exhaust valves and exhaust passages which are in contact with the fuel or gases. Special attention has, therefore, to be paid to water cooling arrangements to insure that the circulation is thorough and that no air or steam pocketing is likely to occur. Particular care should also be paid to the arrangements to prevent short circuiting in the water circulation. In the case of the investigations made, it was found that the major portion of the defects that had arisen on cylinder covers and pistons were due to serious deposits having been allowed to form in the water spaces of the cylinder covers and on the cylinder liners. These deposits were not formed while the engine was working, but after it was shut down. To remedy this, engine users are advised where the circulating water is known to be of a considerable hardness, to run water through the water spaces for some time after the engine has been shut down. Where the piston is not water-cooled the heat units which have been absorbed by the piston crown must be transmitted through the body of the piston to the cylinder liner. The piston must, therefore, be designed to accomplish this result, as well as to provide for the transmission of the load applied to the piston crown to the crosshead pin without causing distortion of the piston. The recent practice has, therefore, been adopted of constructing the piston in two portions. The upper portion is secured to the main body of the piston by six or eight square-necked studs, the support to the crown of the piston top being obtained by throwing out a conical cylindrical chamber, which not only gives an equal distribution of stresses from the load on the piston crown, but also forms another lane by which the heat units can reach the body of the piston for transmission to the water spaces. It also permits of uniform expansion. This design has several advantages, one being that different qualities of material may be used for the upper portion of the piston and the lower. Furthermore, should any cracks develop, it is comparatively simple and inexpensive to replace the top. Experiments have proved that cast iron containing high percentages of phosphorus is most unreliable for pistons, and further investigations established the fact that the elimination of phosphorus would, to a large extent, remove the difficulty of cracks developing. It was found that almost invariably the seizures of pistons were due to heating of the piston pin and its bearing, and that these seizures take place almost immediately after starting up. The opinion was formed that when an engine has been set to work and shut down the heat stored in the piston body flows downwards and tends to evaporate the oil in the top end-bearing, with the result that when the engine starts up again this particular bearing is not amply supplied with lubricating oil and seizures take place. By fitting a hand lubricating pump by means of which lubricating oil under pressure can be pumped to all the bearings, including the piston pin bearing, while the engine is being barred around into its starting position before being started up and again by running circulating water through the engine after shutting down this difficulty is minimized. 9 illustrations. 1,600 words. —*Engineering*, July 16.

The Automobile Torpedo.—A brief résumé is given of a most instructive memoir on the automobile torpedo, published in *Le Génie Civil* of June 26. Attention is first directed to the history of the torpedo, and then the article is confined to a description of the Whitehead torpedo. The Whitehead torpedo as now made consists of the following six parts: (1) The striker and detonator, (2) the explosive chamber, (3) the compressed air reservoir, (4) the machinery chamber, (5) the aft flotation chamber, and (6) the tail portion which carries the propellers and rudders. These various devices are fully illustrated and described and the operation of the torpedo is explained. 8 illustrations. 3,400 words.—*The Engineer*, July 23.

Calculation of Top Girder of a Suction Dredge. (Continuation of article published June 9 and reviewed in our August issue.)—On the strength of the main diagram the author shows that a complete moment curve can be constructed for the load of each longitudinal section, eight in all, or four right and four left analagous ones, each with eight ordinates at the center of section and nine ordinates at supporting points. By adding in the form of a table all the corresponding points, a total moment curve is found from which the stress per square inch of section can be found by the relation to the moment of resistance of the longitudinal girder. From this total moment curve the author deducts the supporting loads at each transverse beam either directly or by integration of the shear and moment curves, and, in relation to the moment of resistance of the transverse beams, finds the stress. The results from the example worked out are given in tabular form. 6 illustrations. 2 tables. 2,300 words.—*Schiffbau*, June 23.

Calculation of the Top Girder of a Suction Dredge (Conclusion of above).—It is pointed out that the stresses upon the longitudinal girder and transverse beams are nowhere excessive. This was due partly to the choice of the support of the transverse beams, as a much higher strain would have been experienced in them if they had been rigidly held at the ends instead of being only supported with a corresponding lower strain in the main longitudinal girder. Attention is also directed to the wide leeway that a designer has in this way, as well as by a choice of variable ratio between the moments of inertia of the girder and beams. A special case is considered where the beams have stanchions down to a center vertical keelson of the ship, of which the elastic deformation is established with resulting change in the forces deflecting beams and girder. In an appendix a quite detailed account is given of the graphical method used. The deflections and their originating forces are represented in diagrammatical form by ellipses of elasticity which may be constructed for any part or weight of girders or beams, and combined into total ellipses from which the varying deflections of the points of, say, a curved beam can be found. After discussing the case of a beam rigidly

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held at one end, the author points out in a general way that ellipses of elasticity can be combined in the same manner as ellipses of moments of inertia, clearly indicating in detail the way in which the deflecting forces and their variations were found in the main diagram of the longitudinal girder. 14 illustrations. 4,900 words.—*Schiffbau,* July 14.

Experimental Methods of the German Government Model Tank, Berlin. (Continuation of article published May 12 and 26 and reviewed in our August issue.)—In this instalment the author shows that for ships exerting a towing pull the race augment and wake gain at the varying speeds in question are more or less constant, which leads to convenient formulas for propeller efficiency and, what the author calls, slip constant, power constant and towing efficiency constant. From the recorded results deductions can be made for six cases: increased towing pull; increased speed; same load at variable speeds; different diameters of propeller; deduction of diameter, slip, horsepower and pull from propeller efficiency. Numerical examples for the six cases are worked out, and the results recorded give full insight into the problem of selecting an efficient tug for a given task, leaving only modifications to be determined by financial and commercial considerations of cost and installation. The next chapter is devoted to propeller efficiency pure and simple, based upon runs with the propeller model without the hull. The thrust, torsional moment and efficiency are determined and recorded for different slips. As an example, an application is made to a twin-screw tug considering the race augment and wake gain. The next chapter deals with propeller experiments constituting a logical development from variable factors of pitch and area ratios. 7 illustrations. 5,400 words.—*Schiffbau,* June 26.

Experimental Methods of the German Government Model Tank, Berlin (Continuation of above).—This article takes up a series of twenty propellers, four each of varying pitch ratio in five groups of varying area ratios. The results are compiled in the form of diagrams from which selections can be made for a propeller to cover given conditions. Two premises are considered: either the diameter is given or the revolutions are given, and an example is worked out for a twin screw motor boat of which the effective horsepower curve is given for progressive speeds. The first case with a given propeller diameter is again further elaborated by also assuming a fixed pitch ratio of 1. Another example is given for a twin screw tug as well as for a single screw tug under altered conditions of slips up to 80 percent and area ratios up to 60 percent in changing the factors in four combinations which in the form of a table show all the important results, with the conclusion for the special conditions that under a towing pull of 4,400 pounds at a speed of nearly three knots, a small pitch ratio, a large diameter and twin screws prove the most desirable. 5 illustrations. Two tables. 3,800 words.—*Schiffbau,* July 14.

The Evolution of the Oil Tank Ship.—By Herbert Barringer. Although there is no written history of the earliest bulk oil carrier, the Chinese Newchwang junk, which was fitted with an expansion trunk and was originally built for the carriage of water in bulk, but afterwards used for oil, must be among the earliest examples of this class of vessel. There is also a record that special instructions were issued as to the carriage of oil up the Volga about the year 1723, and in 1754 the Persians collected oil on Holy Island (near Baku) and conveyed it in sailing vessels, evidently in bulk. These early examples of bulk oil carriage were not much improved until 1875, when the first organized attempt to transport petroleum without the use of tanks or barrels was made by Nobel on the Caspian. In 1878 the first steamship, the *Zoroaster,* was adapted for carrying oil in bulk. The tanks in this vessel were cylindrical in form. The steps by which the present tanker has been evolved are briefly as follows: (1) The introduction of longitudinal and transverse bulkheads, (2) the fitting of expansion trunkways, (3) the provision of cofferdams forward and aft of the cargo tanks, (4) the carriage of oil direct to the skin of the vessel without the use of independent tanks, (5) the abolition of the cellular water ballast double bottom below the cargo tanks, (6) the building of pump rooms extending the whole breadth of the vessel and carried down to the bottom plating of the ship and up to the upper deck, (7) the fitting of compound hatches in order to deal with the carriage of other cargoes than liquid ones, (8) the perfection and elaboration of pumping arrangements, (9) the fitting of mechanical ventilation to tanks, (10) the fitting of steam heating coils in the cargo tanks, and (11) the introduction of liquid fuel in place of coal. Brief descriptions of types of vessels representing various periods in the development of the present-day oil tank steamship are given. It is pointed out that under present circumstances the steam engine is still the most reliable propelling machinery for this type of vessel, although it is conceded that eventually, when mechanical difficulties have been overcome, the internal combustion engine in some form will, to a great extent, displace the steam engine in tank vessels. 2,000 words.—*The Shipbuilder,* July.

The Large Steam Collier Rose Castle.—A description of one of the latest large steam colliers, built by Messrs. Short Bros., Ltd., of Sunderland, to the order of the Rose Castle Steamship Company, Ltd., Liverpool, for the coal trade between Sidney, C. B., and Montreal. The vessel is an Isherwood-framed, single-decked steamer with poop, two short bridges and topgallant forecastle, with the propelling machinery placed amidships. A cellular double bottom used for water ballast and fresh water extends the full length and, in addition, fore-and-aft peaks and wing tanks are provided for ballast when the ship is in light trim. There are seven transverse watertight bulkheads and one steel cross bunker bulkhead. The cargo space is divided into five holds. The length of the vessel overall is 470 feet; between perpendiculars, 455 feet; breadth, extreme, 58 feet; the depth, molded, 33 feet 9 inches; underdeck tonnage, 6,893.85; gross tonnage, 7,545.78; net tonnage, 4,351.28; load draft, 25 feet 6 inches; load deadweight, 11,220 tons; capacity of cargo holds, 548,316 cubic feet; total water ballast capacity, 3,404 tons; bunker capacity, 1,032 tons. There are ten main hatches, two derricks being fitted to each hatch worked by ten 7-inch by 10-inch and two 8-inch by 12-inch steam winches, by which it is expected that the vessel when in service will load a full cargo of coal in six hours and discharge it by grabs in about the same time. Propulsion is by one set of triple expansion engines with cylinders 28½, 47 and 79 inches diameter by 54 inches stroke, supplied with steam by three Scotch boilers 16 feet 1½ inches diameter by 12 feet feet long, fitted with Howden's forced draft and working at 180 pounds per square inch. When developing 3,500 indicated horsepower, the vessel is expected to average 10½ knots. 4 illustrations. 1,400 words.—*The Shipbuilder,* July.

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Shipbuilding and General Marine News

Contracts for New Ships—Marine Terminal Improvements—Recent Launchings—Improved Appliances—Personal Items

During the month several additional orders for large oil tank steamships have been placed in American shipyards, bringing the total deadweight tonnage of oil tankers now under construction in this country close up to 300,000 tons as against over 200,000 tons recorded last month. In addition to the orders mentioned below the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has received an order for two large oil tankers, one a 10,000-ton ship for the Sun Oil Company, Marcus Hook, Pa., and the other for the Union Oil Company, San Francisco, Cal.

Another important feature of the orders placed during the month is a contract for two steam colliers placed with the New York Shipbuilding Company, Camden, N. J., one of which will be the largest collier ever built in the United States for merchant service.

On account of the rush of orders placed in the Atlantic shipyards, filling them up to capacity for months to come, the New York & Cuba Mail Steamship Company (Ward Line), which has been in the market for some time for a 6,000-ton steamship for the New York and West Indies service, was obliged to place the order for this ship on the Pacific coast in order to insure delivery within reasonable time. The Seattle Construction & Dry Dock Company, Seattle, Wash., secured the order.

Recent Shipbuilding Contracts

The Harlan & Hollingsworth Corporation, Wilmington, Del., has received a contract from the Standard Oil Company, New York, for two tank steamers, each to be 425 feet long and to cost about $500,000 (£102,500).

The Harlan & Hollingsworth Corporation has received a contract from the Wilson Line, Philadelphia, Pa. (Philadelphia & Wilmington Steamboat Company), to build a passenger steamer 192 feet long, to cost about $250,000 (£51,250).

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has received a contract from the Standard Oil Company of New Jersey, Bayonne, N. J., to build two tank steamers about 500 feet long.

The Union Iron Works, San Francisco, Cal., has received a contract from the Standard Oil Company of New York for an oil tank steamship 440 feet long, to cost over $1,000,000 (£205,000).

The Wm. Cramp Ship & Engine Building Company, Philadelphia, Pa., has a contract from the Florida East Coast Railway Company, St. Augustine, Fla., to build a steel car ferry which is to be a duplicate of the one which this company built for these owners last year.

The Fore River Shipbuilding Corporation, Quincy, Mass., has received a contract to build a transport for the Argentine Republic.

The Slidell Dry Dock & Shipbuilding Company, Slidell, La., has received a contract from the Mobile Coal Company, Mobile, Ala., to build six barges.

The Collingwood Shipbuilding Company, Ltd., Collingwood, Ont., Canada, has booked an order for two oil tank steamships, 250 feet long, 43 feet beam and 18 feet molded depth to the main deck, for Canadian owners. These ships will be equipped for service either on the Great Lakes or on the ocean and will have a continuous expansion trunk 7 feet 6 inches high running practically the whole length. In each ship there are ten main oil tanks and four lubricating oil tanks, also an oil tank bunker in addition to a coal bunker, as the vessels will be arranged so that either system of fuel can be adopted. The pump room is located forward of No. 1 tank and a small hatch is situated immediately forward of this. Between the first and second tank there is a cofferdam arranged so that gasoline (petrol) can be carried in the two foremost tanks while crude oil can be carried in the remainder, or vice versa. The propelling machinery consists of triple expansion engines and Scotch boilers designed to give the vessels a speed of about 8 knots. The pumping installation and piping is being given special consideration in order that the cargo may be discharged in a very short space of time; separate pumps and piping will be installed for taking care of the lubricating oil. Both ships will be delivered at the opening of navigation next year and both will be built to Lloyd's highest class.

Shipbuilding Contracts Pending

It is reported that W. R. Grace & Company, Hanover Square, New York, will soon receive bids for the construction of a steel steamer to cost about $800,000 (£164,000).

Plans for the six torpedo boat destroyers authorized by the last Congress have been perfected, and bids for their construction will be opened on October 6. These destroyers will have a maximum speed of 30 knots, will displace 1,135 tons and will be 310 feet long.

Shipyard Improvements

It is stated that the Maryland Steel Company, Sparrows Point, Md., has let, or is about to let, contracts for improvements to cost approximately $1,000,000 (£205,000), including a new ways to be 700 feet long, a new machine shop, an extension to the boiler shop and other improvements.

The Hanlon Dry Dock & Shipbuilding Company, San Francisco, Cal., is building a new dry dock and shipbuilding plant on the Oakland inner harbor. It is reported that this dock will have a capacity of 3,500 tons. The new plant will have equipment for shipbuilding and ship repair work.

It is reported in Savannah, Ga., that a large shipbuilding plant will be built in that city. A bill has been introduced in the Georgia Legislature upon the passage of which the building of the plant is said to depend.

Marine Terminal Projects

The Baldwin Locomotive Works, Philadelphia, Pa., is said to have made application for permission to build a large pier on the Delaware River at the foot of the company's property at Eddystone.

The city of Dunedin, Fla., will vote on September 4 on bonds to construct a pier.

The Savannah Dock & Warehouse Company has been organized at Savannah, Ga., with a capital of $100,000 (£20,500) to erect wharves, docks, etc.

The city of Savannah, Ga., will erect a municipal pier and warehouse. Nisbet Wingfield is city engineer.

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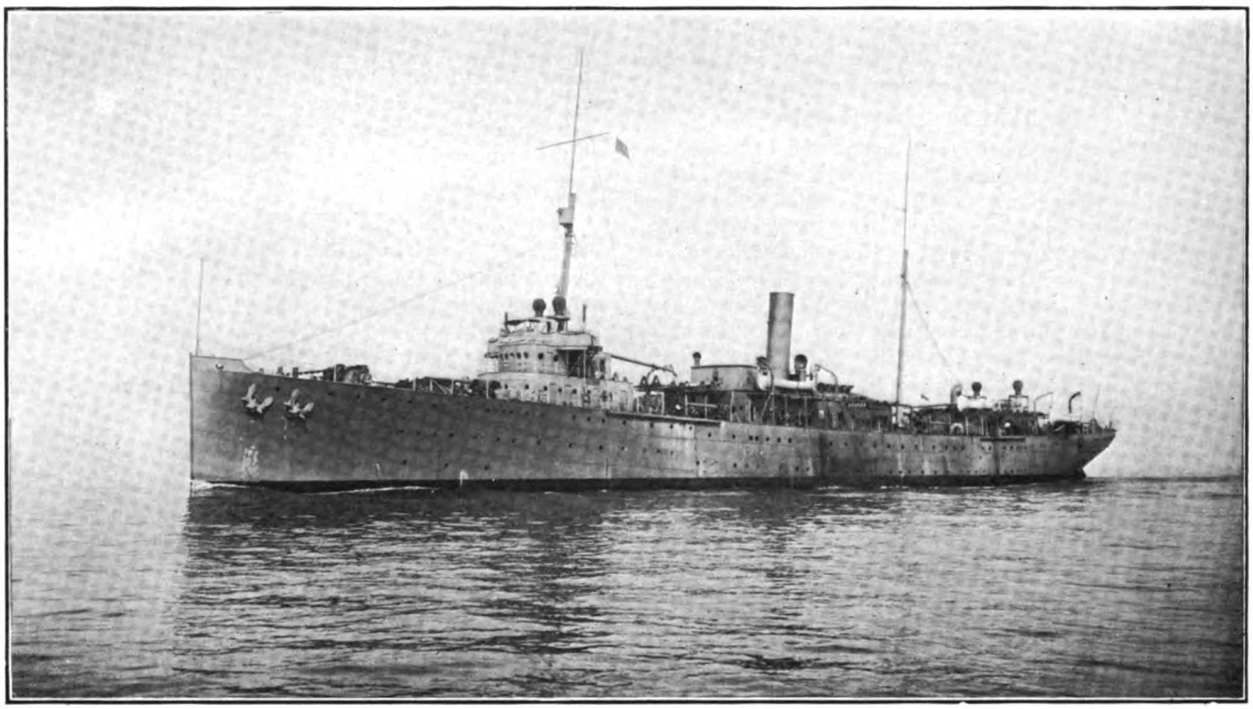


United States Destroyer Tender *Melville*, Recently Completed by the New York Shipbuilding Company, Camden, N. J., for the Navy Department. Propelling Machinery Consists of Parsons Turbines, Driving Through Westinghouse Reduction Gear

Horton & Horton, Houston, Tex., have received a contract from the city of Houston to construct a wharf, cotton sheds, etc., at a cost of about $139,000 (£28,500).

The Houston Terminal Warehouse Company, Houston, Tex., will soon build a dock.

The city of Orange, Tex., has voted $325,000 (£66,700) in bonds for the construction of wharves and docks.

The Carolina Pier Company has been organized at Wilmington, N. C., to build a pier. W. A. McGowan is president.

Charles R. Forbes, chairman of the Board of Harbor Commissioners, Honolulu, T. H., will receive bids on September 22 for the construction of several reinforced concrete piers.

The Georgia Contracting Company, Augusta, Ga., will build a reinforced concrete wharf and warehouse for the city of Augusta.

Charles Campbell, city engineer, St. Joseph, Mo., is having plans prepared for the construction of a dock.

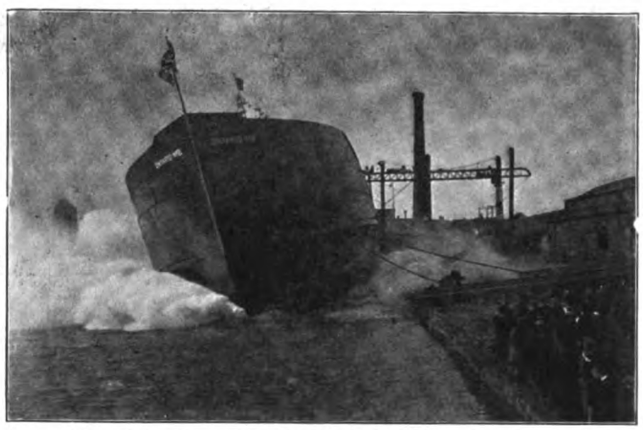
The Standard Oil Company of New Jersey, Bayonne, N. J., will, so it is reported, build a dock at Bayonne.

New Barge Line Incorporated

The Gulf Export & Transportation Company, capitalized at $100,000 (£20,500), all of which is stated to be paid up, has been organized at Beaumont, Tex., to conduct a barge line to be operated between Beaumont and Tampico, Mexico. W. A. Boyie, of Tampico, is president of the organization; C. Christofferson, of Beaumont, is vice-president, and W. E. Sprouse, of Houston, is secretary-treasurer and will be manager of the Beaumont office. Three barges are under construction at Pensacola, Fla., and the *Pilot*, a 150-foot vessel, has been acquired and has been fitted for burning oil.

Another Side Launching on the Great Lakes

Side launchings are universal on the Great Lakes, due to the fact that the shipyards are generally located within the harbors of large ports or on adjacent rivers, and consequently, due to the limited space available, end launching is out of question. In this manner the steel twin-screw car ferry *Ontario* No 2, was launched at the yards of the Polson Iron Works, Ltd., Toronto, on April 3.



Launching of Car Ferry *Ontario No.* 2 by Polson Iron Works, Ltd., Toronto, April 3, 1915

This ferry is of the shelter deck type, 318 feet long and 54 feet beam, and is built with solid plate floors and extra heavy scantlings. She is equipped with transverse and longitudinal bulkheads and has a gross tonnage of 5,400. Plymouth manila ropes 3 inches and 5 inches in diameter were used for launching triggers and mooring lines.

Ontario No. 2 will have a capacity of thirty loaded cars

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and a thousand passengers and will connect the Grand Trunk and Buffalo, Rochester and Pittsburgh railroads between Cobourg, Ont., and Charlotte, N. Y.

New Motor Ship Lara

Although to some considerable extent the manufacture of war materials is delaying the progress of motor ship construction, particularly in England, there are several European Diesel engine concerns that are very busy, among whom are the Werkspoor Company, of Amsterdam, and the most recent vessel that they have equipped with motor power is the *Lara,* while the Werkspoor-Diesel ships *Siberg, Utrecht* and *Boelongan* will shortly be sent out from their works for their trials.

The *Lara* is a small tanker that has just been built for the Anglo-Saxon Petroleum Company, and makes the eighth Werkspoor, four-cycle engined boat that this important oil concern has taken delivery of during the six years since they first ordered the *Vulcanus,* a 1,000-ton deadweight capacity Werkspoor-engined tanker of 500 horsepower, and which has since been in regular service, effecting a saving of about $11,000 (£2,250) per annum for her owners. The *Lara* is of but 875 tons deadweight capacity, but this is considerably more than the capacity of a steamship of similar dimensions; so, apart from the economy effected by the low fuel consumption of about 0.3 pound per indicated horsepower, the advantage of the increased tonnage will be apparent to shipowners.

Her length is 190 feet overall by 32½ feet beam, 14 feet molded depth and 11 feet 9 inches draft. The engine is a six-cylinder, four-cycle type Werkspoor Diesel of the directly-reversible class, developing 650 indicated horsepower at 175 revolutions per minute. This speed is, of course, considerably higher than the higher powered Diesel engines of the same make, which turn at 100 to 125 revolutions per minute, according to the power.

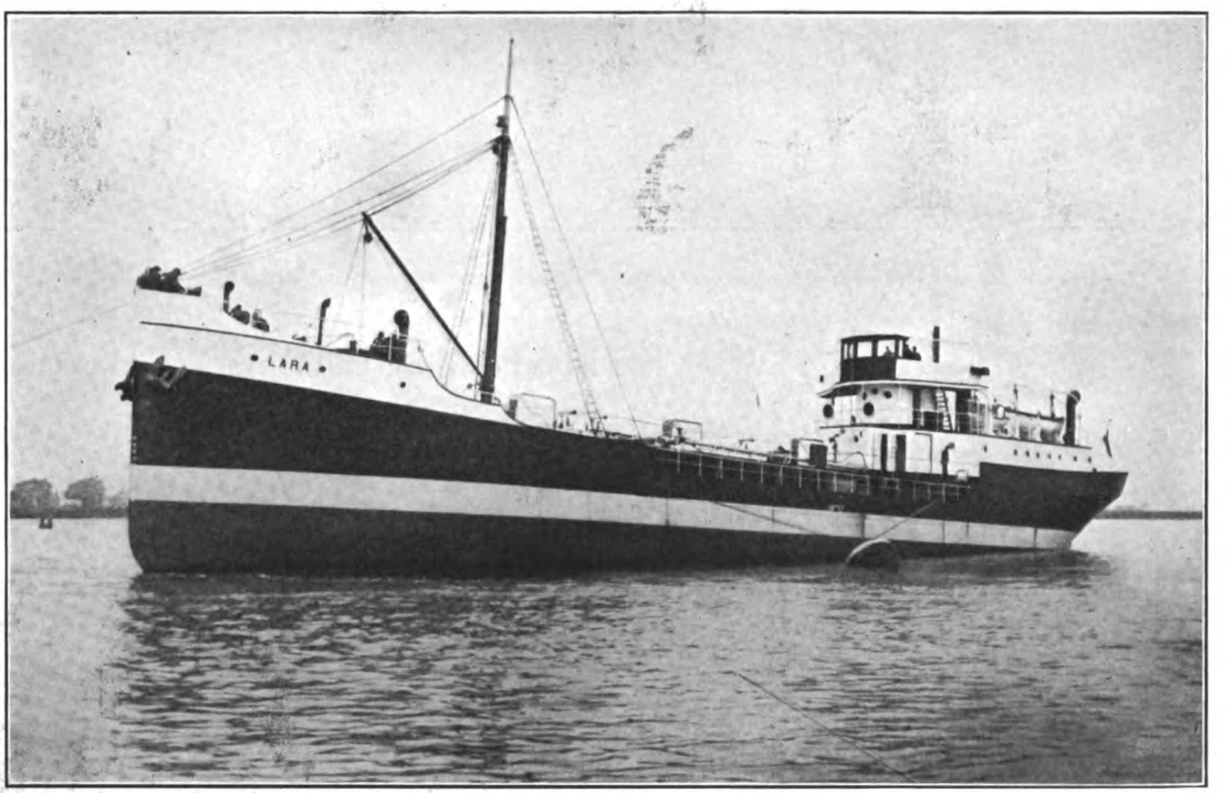
In America it is generally thought that high-powered marine Diesel engines are more expensive than domestic built steam engines and boilers, but the contrary is the real position, and the makers of the engine of the *Lara* can deliver such engines at their works at prices from 30 to 40 percent lower.

Motor Ship Gallia

At the time she was built, early last year, the motor ship *Gallia,* illustrated on the opposite page, was the highest powered motor vessel in which hot bulb engines of the Bolinders type had been installed. Since then other vessels have been built in which the power equals or exceeds that of the *Gallia.*

The *Gallia* was built in Holland as an oil tank vessel for Messrs. P. van Ommeren, of Rotterdam, and is 190 feet long, 33 feet 6 inches beam and 18 feet depth, with a load draft of 16 feet 4 inches. Her deadweight carrying capacity is 1,630 tons and she is propelled by two 320 brake horsepower, four-cylinder Bolinders direct reversible engines operating at a normal speed of about 225 revolutions per minute. The motors were supplied by Messrs. Becker & Co., of The Hague, and Bolinders engines were also supplied for operating the windlass and for operating the air compressor and steering gear. Both of these auxiliary engines were of 10 brake horsepower.

The total machinery weight is about 61 tons, and, as can be seen from the photographs, the machinery installation occupies a comparatively small space, giving ample room between the two engines. There are two separate silencers for each engine—one for each pair of cylinders. The exhaust pipes are joined and lead up through the



Werkspoor-Diesel-Engined Oil Tanker *Lara,* Recently Built for the Anglo-Saxon Petroleum Company

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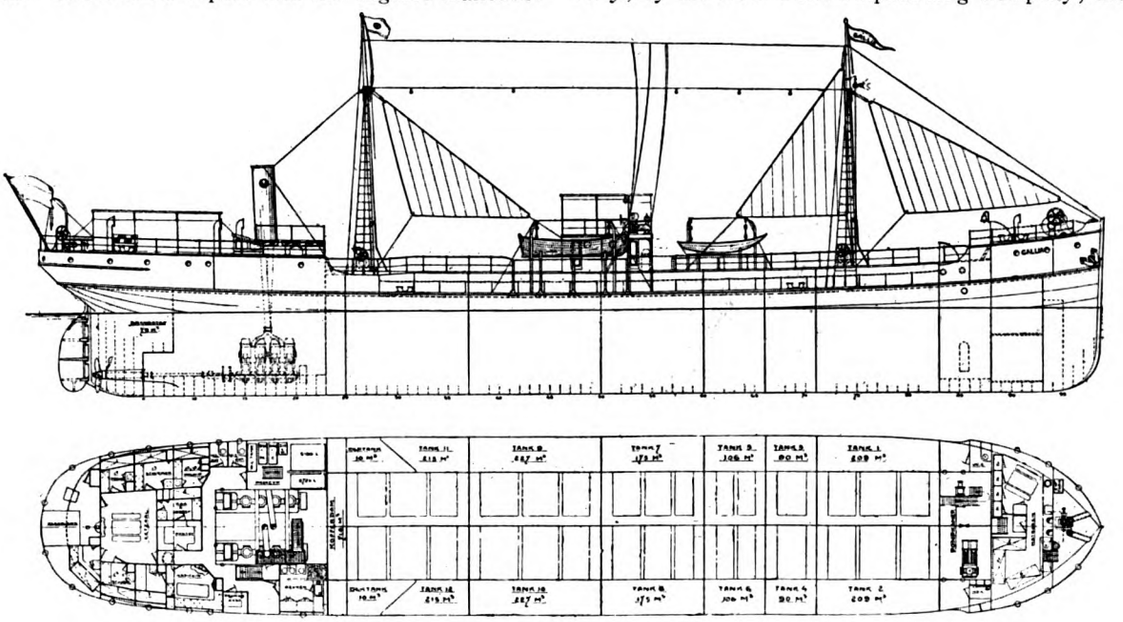
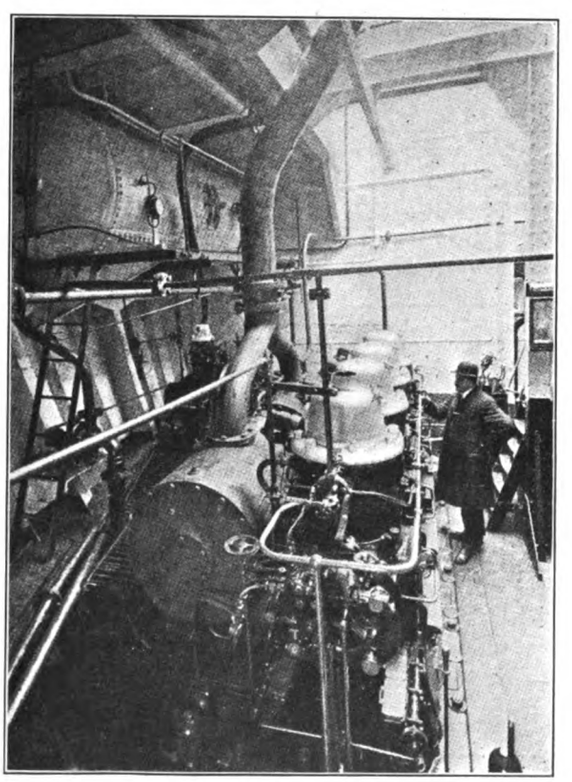
funnel. The crude oil consumption of the engines with the vessel running on long trips, fully loaded, at about eight knots speed, was .55 pound per brake horsepower per hour. The owners report that the engines maneuver very easily and quickly and do not race in rough weather. Two similar Bolinders installations have recently been made consisting of twin screw sets of two 320 brake horsepower engines each for the motor ships *Drente* and *Limbung*. Another important installation of Bolinders engines has been made in the auxiliary yacht *Belem*, purchased by the Duke of Westminster.



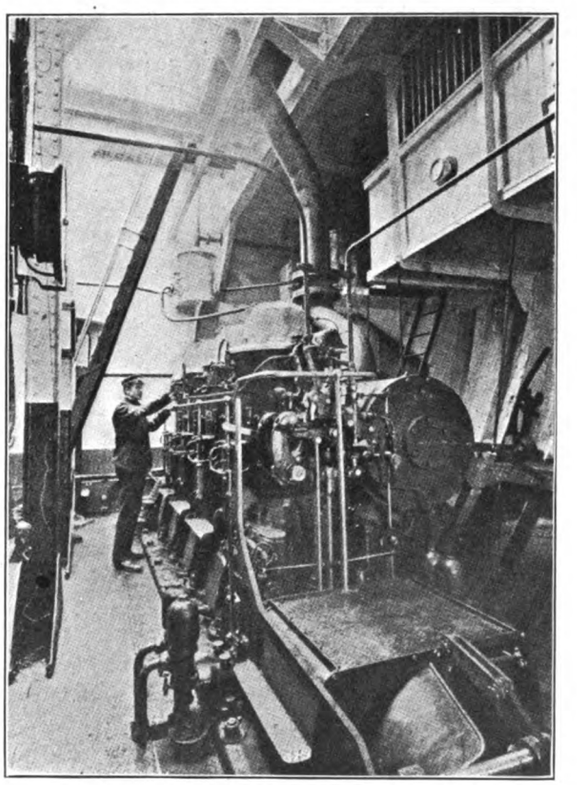
Plans of Motor Tank Ship *Gallia*, Fitted with Two 320 Horsepower Bolinder Oil Engines

Recent Launchings

Among the vessels launched during the last month were the steam collier *Franklin*, under construction at Camden, N. J., by the New York Shipbuilding Company; the government hydraulic hopper dredge *San Pablo*, which is being built by the Baltimore Drydocks & Shipbuilding Company, Baltimore, Md.; the torpedo boat destroyer *Porter*, at the yards of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., and two of the ten submarines which the Fore River Shipbuilding Corporation is building at Quincy, Mass., for Great Britain.



Port Engine



Starboard Engine

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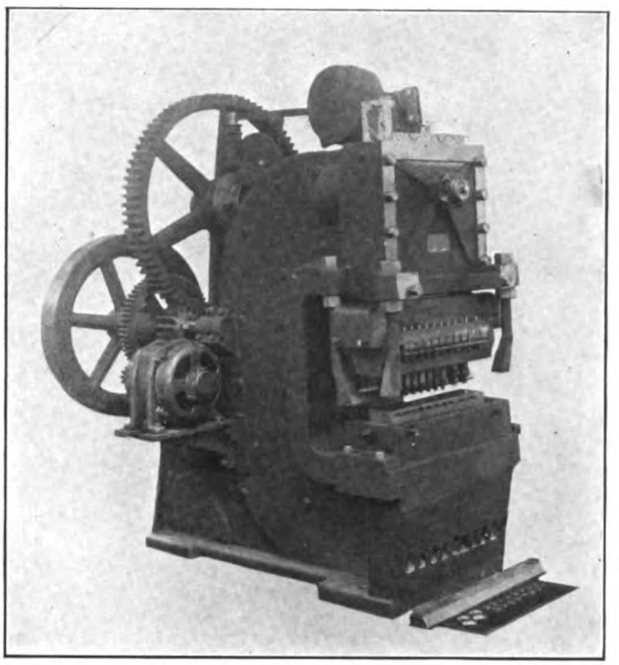
ENGINEERING SPECIALTIES

Multiple Punch with New Features

The illustration shows a new multiple punching machine recently designed and built by Bertsch & Co., Cambridge City, Ind. It has a cored or box section frame. There are twenty punching units in the head, each one of which

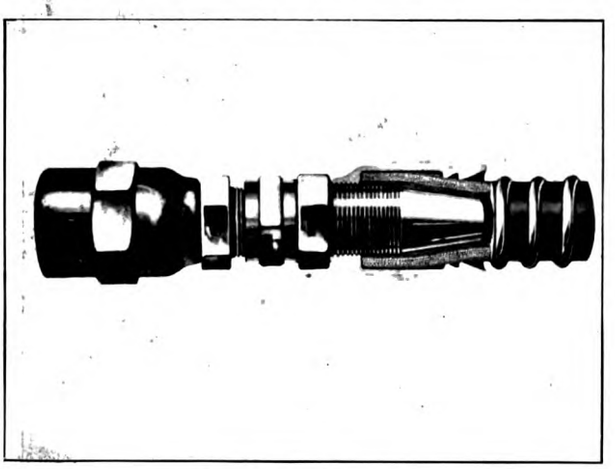


Multiple Punch with Special Couplings

is gaged so that any number of punches from one to twenty can be either used or disengaged, as desired. Sixteen of the punches were too close together for standard couplings; therefore special couplings were used, clearly shown in the cut, on which the builders are applying for a patent.

Coupling for Compressed Air Hose

The National hose coupling, manufactured by the National Hose Coupling Company, Peoples Gas Building, Chicago, Ill., has been designed to eliminate the necessity of special clamps to effect a grip on the ends of the hose. The coupling consists of a malleable iron hose socket, sufficiently corrugated on the inside to provide a positive grip when the hose is expanded by screwing into the socket a steel taper expander which forces the hose outward and into position. No attempt is made to contract the outside of the hose, but all the stress is applied from the inside. The hose readily enters the socket and may be cut and recoupled as often as required. The edge of the socket and the end of the expander are smoothly rounded to prevent injury to the hose. A single wrench suffices for adjusting the coupling, making the operation of connecting or disconnecting simple and convenient.

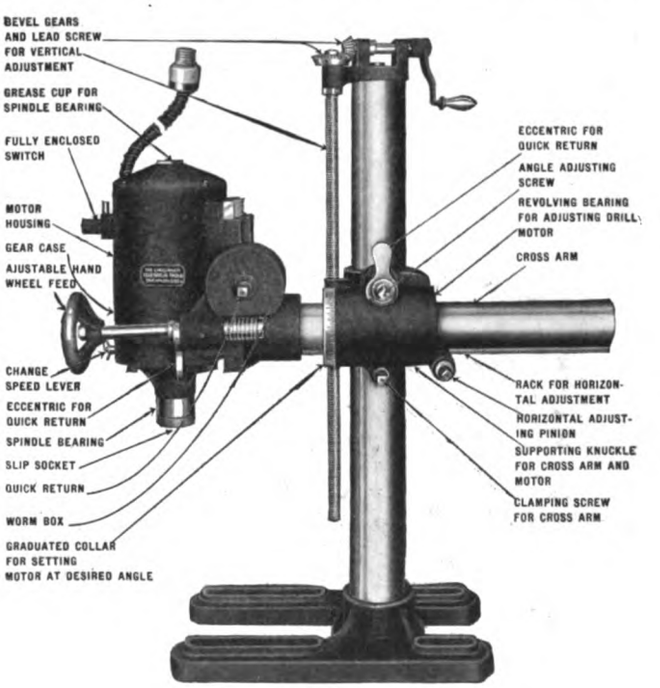


National Hose Coupling

Cincinnati Portable Scotch Radial Drill

A handy tool which is in general use in machine shops, construction work, navy yards, arsenals and on board naval vessels is manufactured by the Cincinnati Electrical Tool Company, Cincinnati, Ohio, known as the "Cincinnati" improved type portable electrical Scotch radial drill. Driving power is obtained from an ordinary lamp socket, so the tool can be used wherever electric power is available.

The motor drill and the knuckle have a vertical adjustment on the upright column by means of a worm and



Cincinnati Portable Radial Drill

worm wheel through a 34-inch lead screw and a horizontal adjustment by means of a rack on the cross arm and pinion in the knuckle. The revolving bearing in the knuckle which supports the cross arm has a graduated collar, so that the operator can set the drill at any desired angle. This is done by means of the worm and worm wheel in the knuckle, which also prevents the motor from turning or dropping while adjusting it.

The motor is of a heavy duty type, air cooled, fully enclosed and dirt and dust proof. It can be set at any angle and has a circle radius of 24 inches. It has a 10-inch feed through a hand wheel with quick return. The hand wheel and worm box are adjustable to drill in either

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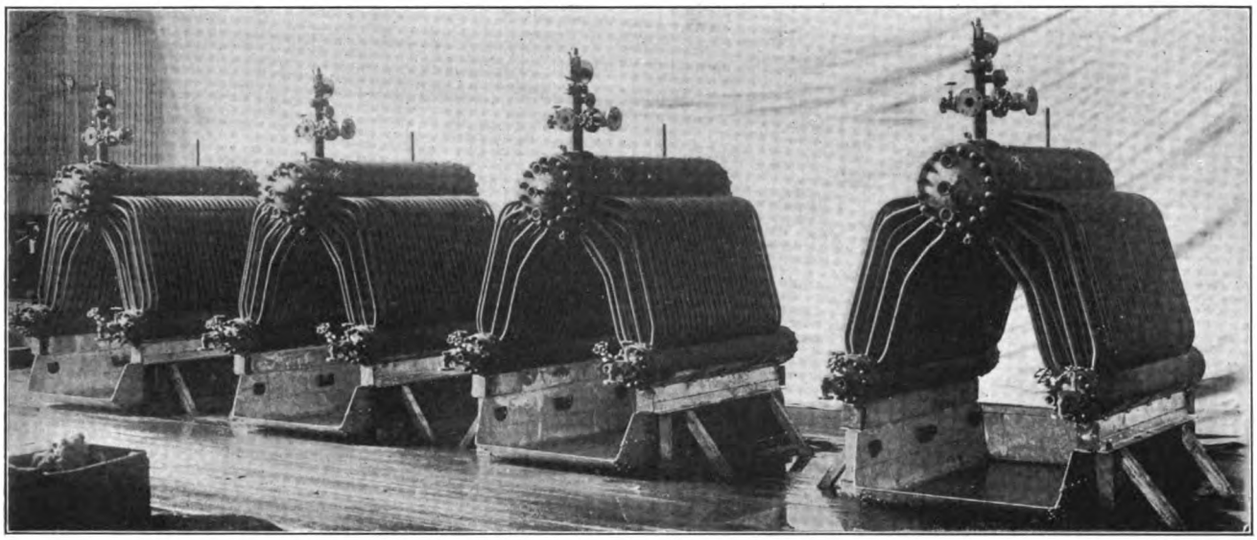

Fig. 1.—New Type Navy Boilers, Built by Charles L. Seabury & Company, Morris Heights, New York

a horizontal or vertical position, allowing the operator to get into close corners. All adjustments it is claimed, are positive and under immediate control. The motor is equipped with a special type slip socket, doing away with the drift key and drift holes in the spindle and spindle bearing, preventing dirt and borings getting into them.

This drill is made in three sizes, 1¼, 2 and 2½-inch capacities, with single and two speeds.

New Type Navy Boiler

The eight boilers recently purchased by the Navy Department under Navy Schedule 7865, class 141, have been delivered by Charles L. Seabury & Company, of Morris Heights, New York City, after passing every test. Four of these boilers are illustrated in Figs. 1 and 2. They are of the "Seabury" safety watertube type, designed to operate under 165 pounds steam pressure, though a hydrostatic pressure of 500 pounds was successfully applied. The dimensions are as follows:

Length of casing, 4 feet 3½ inches; width, 4 feet 4 inches; height, including ash pan, 5 feet 6½ inches; grate surface, 12.5 square feet, and heating surface, 240 square feet. The upper or steam drums were of 15 inches outside diameter, lap-welded steel plate ½ inch thick, and the lower or mud drums were of the same material, 8⅝ inches outside diameter, and 5/16 inch thick. The generating tubes were of 1 inch O. D., No. 12 B. W. G. of seamless drawn steel cold bent to shape.

The boilers were fitted with flanges, in accordance with the Bureau of Steam Engineering Standard Flange List No. 8-A, and complete with fittings and casing, weighed each, dry, 3,800 pounds.

Hanna Combination Yoke Riveter and Punch

The Hanna Engineering Works, 2059 Elston Avenue, Chicago, Ill., has recently placed upon the market the combination yoke riveter and punch illustrated. As a riveter this machine is well known and is being extensively used in the fabrication of steel throughout the country. A description of a 100-ton riveter of this type appeared in the May issue of INTERNATIONAL MARINE ENGINEERING. The machine illustrated is arranged with special die and anvil for punching flanges of 6-inch to 10-inch channels. An

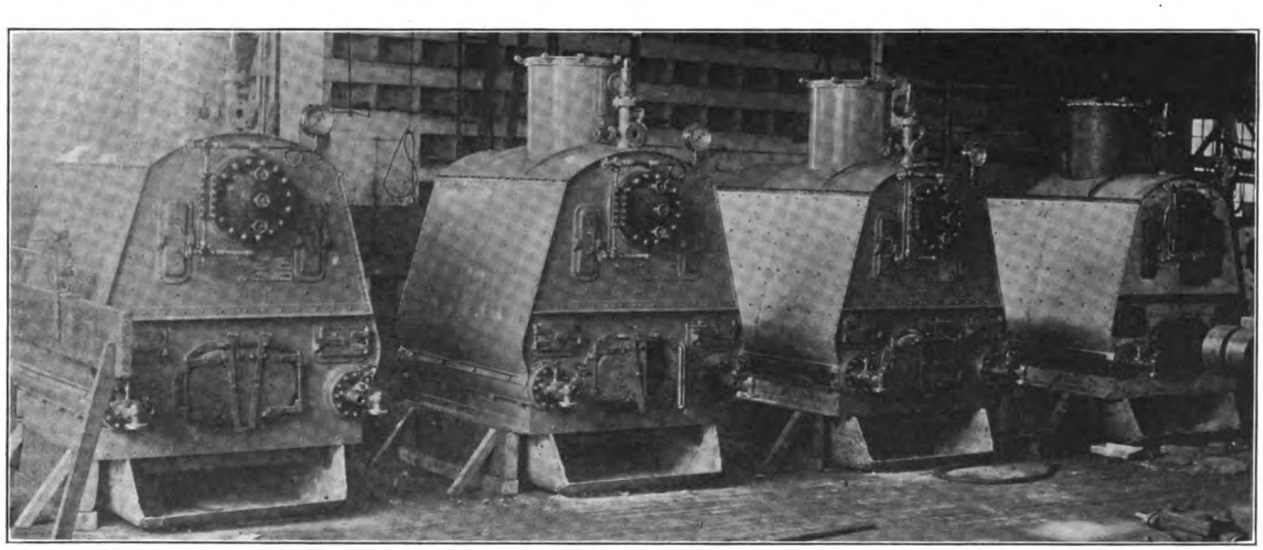

Fig. 2.—Four of New Type Navy Boilers Complete, With Casings and Fittings

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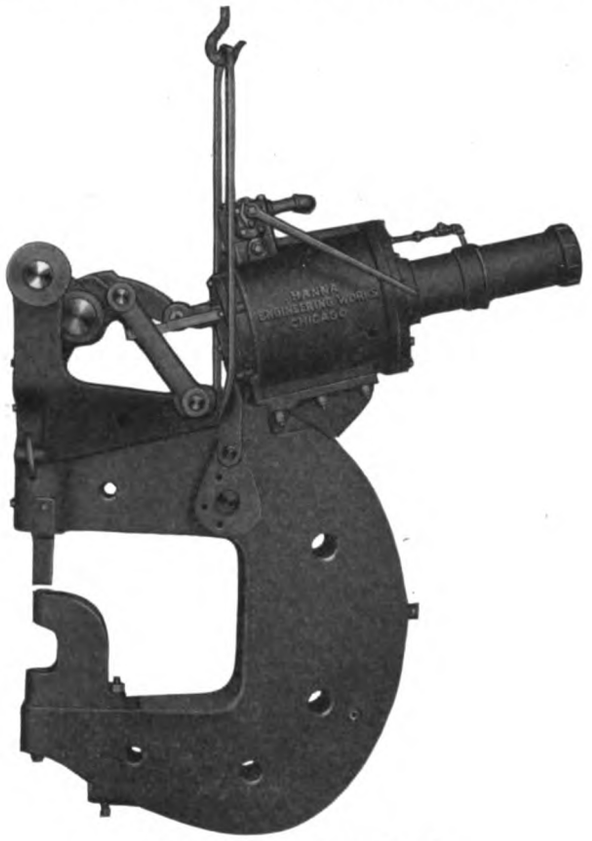
auxiliary dash-pot mechanism automatically absorbs all shock after the die has passed through the plate. For punching bent ship channels, it is claimed, the machine



Hanna Yoke Riveter and Punch

will effect considerable savings in time and labor over the usual method of routing this work through the shop.

The punch or rivet die in this machine is operated through the combined toggle and simple lever motion which is characteristic of all Hanna pneumatic riveters.

PERSONAL MENTION

Operating Engineers

Alex. Rehnberg has been appointed chief engineer of the steamship *San Marcos.*

James Lawton is chief engineer of the American-Hawaiian steamer *Ohioan.*

G. J. Perry, of New Orleans, La., has been appointed first assistant engineer of the steamer *Morse.*

Cyrus C. Yarter has been appointed first assistant engineer of the tug *Yosephie,* Schenectady, N. Y.

D. W. Cross, of New Orleans, La., has been appointed first assistant engineer of the steamer *Santurce.*

A. W. Baird, of New Orleans, La., has been appointed third assistant engineer of the steamer *Mexicano.*

D. W. Grace, of New Orleans, La., has been appointed second assistant engineer of the steamship *Santurce.*

George McCord, of New Orleans, La., has accepted the position as chief engineer of the steamship *McDougall.*

William Pilante, of New Orleans, La., has been appointed second assistant engineer of the steamer *Mexicano.*

Samuel J. Ryan has been appointed chief engineer of the tug *Yosephie,* engaged on barge canal work at Schenectady, N. Y.

Henry Ryan has been appointed second assistant engineed of the steamer *Berkshire,* of the Hudson Navigation Company, New York.

Winnie Norris has been appointed first assistant engineer of the steamer *Greenport,* of the Hudson Navigation Company, New York.

George W. Morey has been appointed chief engineer of the steam tug *Betty,* used at the State Dam on the Hudson River at Troy, N. Y.

George Mason, formerly chief engineer of the steamship *San Marcos,* has been appointed chief engineer of the steamer *San Jacinto,* vice George Ross, deceased.

Chris Jadatz, first assistant engineer of the steamer *Berkshire,* of the Hudson Navigation Company, has accepted a position at the Keeler Hotel, Albany, N. Y.

Paul Maltias recently resigned on account of illness from the position of first assistant engineer of the steamer *Greenport,* of the Hudson Navigation Company, New York.

James Andus has been appointed chief engineer of the steamer *St. Johns,* of the Potomac & Chesapeake Steamboat Company, Washington, D. C., with James Nash as his assistant.

Henry Stammell, of the tug *James A. Morris,* at Albany, N. Y., has been appointed chief engineer of the steamer *William H. Kinch,* of the Great Lakes Dredge & Dock Company.

S. P. Hinckley is chief engineer of the steamer *Pacific,* which recently sailed from New York to Pacific ports. F. Daly is first, P. P. Hinckley second and E. A. Lewis third assistant engineer of this vessel.

Hubert Dicks has been appointed chief engineer of the Lake-built steamship *Arlington,* now fitting out at the Newport News Shipbuilding & Dry Dock Company for the New England Coke & Coal Company, of Boston, Mass.

George B. Langin is chief engineer of the new tug *Mary M.,* employed by the Randerson Construction Company, Albany, N. Y. This tug was formerly called the *Chester* and was recently thoroughly rebuilt at Albany, N. Y.

George C. Glazer, second assistant engineer of the United States lighthouse steamer *Orchid,* has been transferred to the lighthouse steamer *Laurel,* succeeding H. D. Reilly, who has been transferred to the lighthouse steamer *Holly.*

William Lambert is chief engineer of the steamer *Charles H. Werner,* which arrived in Washington on July 31, under charter to run excursions to River View for the balance of the season. Captain John Mills is in command of this vessel.

P. J. Killian, chief engineer of the government tug *Colonel Thayer,* has resigned to accept a position with the Great Lakes Dredge & Dock Company, Albany, N. Y. James Hayes has been appointed chief engineer of the *Colonel Thayer.*

J. R. Cohen is chief engineer of the steamer *El Cid,* which recently underwent repairs at Tietjen & Lang's yard, Jersey City, N. J. C. E. Davidson, W. C. Dowe and W. W. Adams are first, second and third assistant engineers respectively on this vessel.

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George Smith, chief engineer of the steamer *St. Johns*, of the Potomac & Chesapeake Steamboat Company, Washington, D. C., has been transferred to the steamer *Volunteer* of the same company, to superintend the repairs occasioned by a recent fire on this vessel.

John Carey, chief engineer of the steamship *William H. Kinch*, has been appointed first assistant engineer of the *Berkshire*, of the Hudson Navigation Company, New York. Mr. Carey was formerly first assistant engineer of the steamer *C. W. Morse*, of the Hudson Navigation Company.

M. A. Parker, formerly chief engineer of the steamer *Peter H. Crowell*, of the Crowell & Thurlow Company, Boston, Mass., has been appointed chief engineer of this company's new steamer *W. D. Noyes*, recently built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

J. H. McNamara is chief engineer of the Virginia oyster police steamer *Phillips*, which has recently been brought to the wharf of Messrs. Forsberg & Murray for extensive repairs to her boilers and machinery and to have new water tanks installed. Captain O. W. Hudson is in command of this vessel.

L. C. Potteiger is in charge of the engine room of the steamer *Castle*, of the United States Army Engineer Service, which was recently sent from Washington, D. C., to Urbanna, Va., at the mouth of the Rappahannock River, where the government dike, built to protect the dredged channel leading into Urbanna, is being repaired. Engineer Harrison, from the office of Colonel Newcomer, engineer officer in charge of this district, is in charge of this work.

Naval Architects, Consulting Engineers and Shipyard Officials

Colquhoun F. Grant, for seventeen years senior assistant superintendent engineer of the Clan Line of steamships, London, has been appointed superintendent engineer of this line, vice John Lyall, deceased.

G. M. Bosworth has been elected chairman of the Canadian Pacific Steamships Company, Ltd., at Montreal, and H. Maitland Kersey has been appointed managing director of the company, with offices in London.

G. B. McAlpine, for the past sixteen years employed in the hull drafting department of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been appointed hull inspector of the Lake Torpedo Boat Company, Bridgeport, Conn.

Commander H. I. Cone, U. S. N., formerly chief of the Bureau of Steam Engineering and recently commander of the torpedo flotilla tender *Dixie*, was assigned on July 27 to the Panama Canal as marine supsrintendent, succeeding Captain Hugh Rodman, ordered home to await orders.

Captain Albert Weston Grant, U. S. N., was recently appointed by the Secretary of the Navy as head of the United States submarine service. Captain Grant's headquarters are at present on the old cruiser *Columbia*, which is now the mother ship of submarines at the Philadelphia Navy Yard.

Homer L. Ferguson, formerly general manager of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been elected president of this company, vice A. L. Hopkins, deceased. The following appointments have been announced by President Ferguson: F. P. Palen, assistant to the president, New York City; S. L. Wood, assistant to the president, Newport News; W. H. Benson, assistant to the president, Newport News.

C. C. Lacey, marine superintendent of the Great Northern Pacific Steamship Company, Seattle, Wash., resigned his position on July 1. Mr. Lacey was formerly marine superintendent of the Great Northern Steamship Company at Seattle and superintended the construction of the *Minnesota* and *Dakota*, built for this line at New London, Conn., in 1904. Mr. Lacey also superintended the construction of the fast turbine passenger and freight steamers *Great Northern* and *Northern Pacific* recently built by William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., for the Great Northern Pacific Steamship Company.

The secretary of the British Admiralty announced on July 5 that Admiral of the Fleet Lord Fisher of Kilverstone has been appointed chairman of the Inventions Board established to assist the Admiralty in coördinating and encouraging scientific effort in relation to the requirements of the naval service. Other members appointed to the central committee were Sir J. J. Thomson, O. M., F. R. S.; Hon. Sir C. A. Parsons, K. C. B., F. R. S., and G. T. Beilby, F. R. S. Members appointed to the panel of consultants which will advise the central committee included the following: Professor H. B. Baker, F. R. S.; Professor W. G. Bragg, F. R. S.; Professor H. C. Carpenter; Sir William Crookes, O. M., F. R. S.; W. Duddell, F. R. S.; Professor Percy Frankland, F. R. S.; Professor Bertram Hopkinson, F. R. S.; Sir Oliver Lodge, F. R. S.; Professor W. J. Pope, F. R. S.; Sir Ernest Rutherford, F. R. S.; G. Gerald Stoney, F. R. S., and Hon. R. J. Strutt, F. R. S.

OBITUARY

Robert A. Snyder, president of the Saugerties Steamboat Company, Saugerties, N. Y., died on July 27 at Saugerties, aged 79 years. Mr. Snyder was also president of the Saugerties Manufacturing Company, the First National Bank of Saugerties and other corporations.

David A. Wasson, who has contributed many interesting articles to recent issues of INTERNATIONAL MARINE ENGINEERING, died recently at his home in Colorado Springs, Col., aged 30 years. Mr. Wasson was a grandson of David Wasson, of West Brookfield, Me., a prominent shipowner and shipbuilder. The name of Wasson, before and during the Civil War and for years after, was widely known throughout the United States by shipping men. Before his health failed, Mr. Wasson lived at Kittery Point, Me., where his parents are still living. Mr. Wasson's father is also an artist and a writer of distinction.

Henry Alexander Mavor, a pioneer in electric lighting and electrical manufacturing in England, and one of the founders of the firm of Mavor & Coulson, Ltd., died at Mauchline, Ayrshire, July 16, aged 57 years. Mr. Mavor entered the electric lighting field in 1879, working under the direction of Mr. R. E. Compton and afterward installed the first electric lighting plant in Glasgow, from which the present municipal system has grown. In later years Mr. Mavor gave his attention to the manufacture of electrical apparatus, and he secured many patents on inventions relating to the electric propulsion of ships and carried out experiments with a 2,000-ton vessel which gained him wide recognition from naval architects and engineers. He was called into consultation in connection with the design and construction of the electrical propelling machinery for the U. S. collier *Jupiter*.

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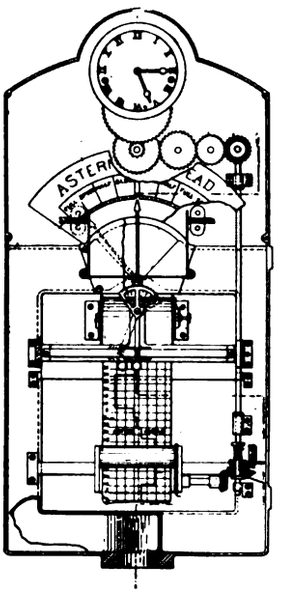
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Derbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,138,226. MARINE SPEEDOMETER. CHARLES H. KENNEY, OF NEW LONDON, CONN.

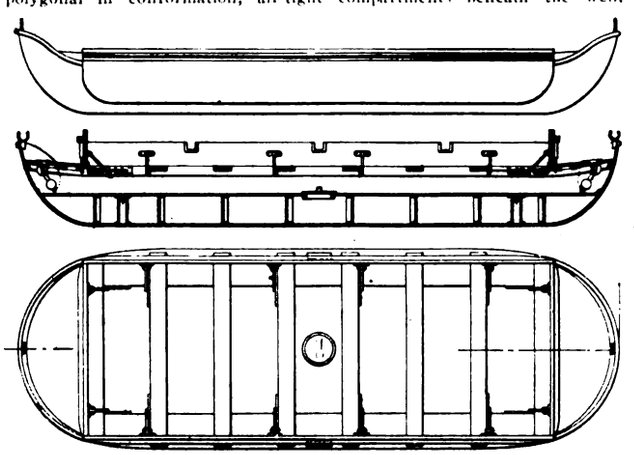
Claim 1.—In a marine speedometer adapted to indicate and record direction and speed ahead and astern by corresponding dips of a pointer and record diagrams, a case, an air duct in said case, a movable abutment in said duct adapted to be moved by varying air tension on opposite faces, a pointer operably connected with said movable abutment,



and thereby dipped in opposite directions to indicate respectively speed ahead and astern, a record tape, tape supporting means adapted to support said tape, tape-feeding means adapted to cause a feed motion of said tape, a marker adapted to mark said tape, and marker-shifting means operably connecting said movable abutment and marker and adapted to move said marker synchronously and in the same direction with said pointer. Eleven claims.

1,140,469. BOAT. ANDREAS P. LUNDIN, OF BAYSIDE, N. Y., ASSIGNOR TO WELIN MARINE EQUIPMENT COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—A lifeboat comprising a metallic shell having a well, polygonal in conformation, air-tight compartments beneath the well,



marginal and cross seats connected to the shell at the upper edge of the well, a superstructure composed of rigid side and end members hinged to the shell and adapted to fold inwardly and means for automatically locking such side and end members when the same are moved into raised position. Five claims.

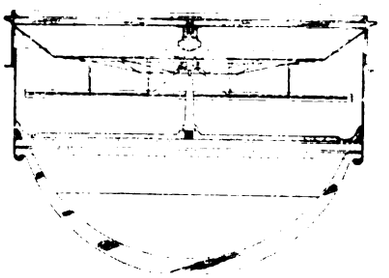
1,142,530. SCREW PROPELLER. WILLIAM ROWTHORNE, OF SOUTHAMPTON, ENGLAND.

Claim 1.—A screw propeller comprising blades, each having an annular, apertured hub-portion, of reduced thickness, and each blade having lateral shoulders at the hub end thereof, but not contained in the reduced portion; said hub portions being superposed to make a laminated hub for the propeller; and said shoulders of one blade abutting shoulders of adjacent blades. One claim.

British patents compiled by G. F. Redfern & Co., chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

11,881/1914. IMPROVEMENTS IN OR RELATING TO MAGNETIC COMPASSES. M. B. FIELD, KELVIN; BOTTOMLEY & BAIRD, LTD., CAMBRIDGE STREET, GLASGOW.

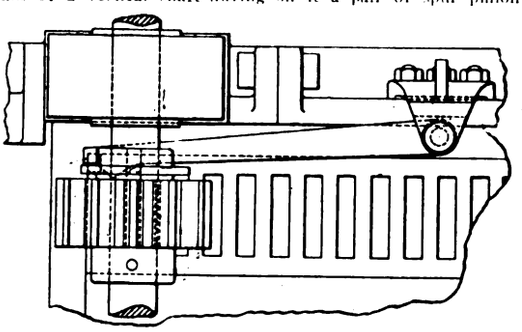
The primary object of the invention is the provision of a dry card having all-round attributes approximating as nearly as possible to those of the standard ten-inch card, but comprising an index of a diameter of about seven or eight inches, so disposed that it may be used in conjunction with a lubber point or a screen bearing a lubber mark, said point



or screen being attached to the bowl or bezel and brought into the immediate neighborhood of the index in such a manner that the card is free to tilt in relation to the bowl and *vice versa* without fouling said lubber mark or screen. A further object is to provide a sharp, truly circular and translucent edge to the index and so to support the latter that the silk threads usually employed do not underlie the degree markings of the index, so that when illuminated from below and viewed from a position vertically above (as is virtually the case when the optical system is used) the index graduations may be plainly seen.

15,770/1914. IMPROVED MEANS FOR RETAINING BULKHEAD DOORS IN THEIR OPEN POSITION. HARLAND & WOLFF, LTD., AND W. E. ARMSTRONG, QUEEN'S ISLAND SHIPBUILDING & ENGINEERING WORKS, BELFAST.

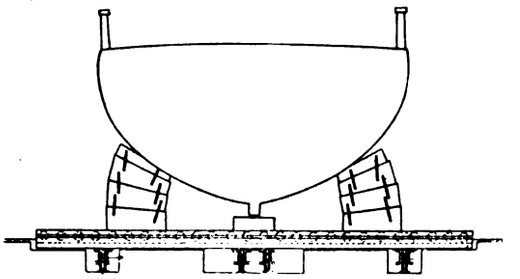
This invention relates to improved means for holding a bulkhead door in the open position and preventing it from moving when the ship rolls. It is especially suitable for use with a horizontally moving door actuated by means of a vertical shaft having on it a pair of spur pinions en-



gaging a pair of racks on the door. According to this invention there is provided a catch which is hinged to the door frame by a horizontal pin and is adapted to drop in front of a shoulder on the door when the latter is fully open, but to be lifted out of engagement with the shoulder by a cam on the shaft. The pinions are not fast on the shaft, so that when the shaft is turned to close the door it rotates through a small angle and thus causes the cam to lift the catch, and then it turns the pinions and opens the door.

15,661/1914. SLIPWAYS. S. H. GORDON, BRITON LODGE, TELFORD STREET, INVERNESS.

Claim.—A set of longitudinally disposed rails supporting a corresponding series of flanged wheels journaled in the main longitudinally moving slip carriage. The said carriage carries a set of rails disposed



transversely of the rails and constituting ball race co-operating with a series of balls contacting with a series of interconnected races supported by rails constituting a chassis for supporting the boat. Desirably the said balls are mounted in an interconnected series of cages, the ball-engaging surfaces of which are of synclastic formation so that the cage is supported by said ball, said cages being capable of disconnection so as, when the chassis is shifted, to be removable from the retreating side and be capable of being fed under the advancing side.

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